Alaska Department of Environmental Conservation

Amendments to:
State Air Quality Control Plan Vol. III:

Appendix III.D.7.07

{Appendix to Volume II. Analysis of Problems, Control Actions; Section III. Area-wide Pollutant Control Program; D. Particulate Matter; 7. Fairbanks North Star Borough PM2.5 Control Plan, Serious Requirements}

Adopted

November 19, 2019

Michael J. Dunleavy
Governor

Jason W. Brune
Commissioner

(This page serves as a placeholder for two-sided copying)

Appendix III.D.7.07

Contents

Evidence of Implementation of Moderate Area SIP Control Measures

Best Available Control Measures Analysis for Fairbanks $PM_{2.5}$ Nonattainment Area

The following document is included as part of the BACM analysis, however due to its electronic nature, it may be found posted separately at: http://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-serious-sip/

- AppIII.D.7.07_BACM_Economic_Analysis_Final.xlsx (2MB)

Fairbanks North Star Borough Resolution No. 2019-08 – A Resolution Supporting the Alaska Department of Environmental Conservation, Division of Air Quality to Issue Civil Fines for Violations in Areas Classified Serious Nonattainment Areas

NESCAUM Emission Profile Comparison of Catalyst vs Non-catalytic Woodstove

Alaska Department of Environmental Conservation – Residential Fuel Expenditure Assessment of Transition to Ultra-Low Sulfur No. 1 Heating Oil for the Fairbanks $PM_{2.5}$ Serious Nonattainment Area

Fairbanks North Star Borough Transit Fleet Natural Gas Efforts

- Fairbanks North Star Borough – Compressed Natural Gas Feasibility Study Final Report
- Fairbanks North Star Borough Resolution No. 2019-03 - A Resolution Supporting the Conversion from Diesel and Gasoline to Compressed Natural Gas (CNG) Vehicles for All Transit Revenue Service Vehicles within the Fairbanks North Star Borough Transportation Department (Adopted February 19, 2019)
- Fairbanks North Star Borough Ordinance No. 2017-20-2D – An Ordinance Amending the FY 2017-18 Budget by Appropriating $260,251 in Federal Grant Funds and $25,834 in State Matching Funds to the Transit Enterprise Projects Fund to Acquire Four New Paratransit Vans
- Fairbanks North Star Borough Ordinance No. 2017-20-1E - An Ordinance Amending the FY 2017-18 Budget by Appropriating $1,742,800 in Federal and State Grant Funds, and $97,100 from Transit Enterprise Fund Unrestricted Net Position to Acquire Four New Transit Buses

BACT Determinations for Point Sources:

- Fort Wainwright US Army Garrison and Doyon Utilities BACT Documents

2015-04-24 ADEC Voluntary BACT Analysis for Fort Wainwright (Privatized Emission Units) letter to Eric Dick.pdf
2015-04-24 ADEC Voluntary BACT Analysis for Fort Wainwright (Privatized Emission Units) letter to Kathleen Hook.pdf
2015-10 DU FWA BACT Protocol V2.pdf
2015-12-11 DU BACT Protocol Cover letter V2.pdf
2016-02-03 DU_BACT_protocol_response.pdf
2017-01 S&L SCR Cost Development Methodology.pdf
2017-06 Final BACT_BACM Analyses Tech Memo_NEW.pdf
2017-06-05 Fort Wainwright DSI Amerair Industries LLC Proposal.pdf
2017-06-27 Page 1-2 Markup.pdf
2017-06-27 Page 9-1 Markup.pdf
2017-07-10 Cover Letter.pdf
2017-10-20 ADEC BACT Comment Letter Fort Wainwright.pdf
2017-10-20 ADEC Request for Additional Information for Fort Wainwright BACT Analysis.pdf
2018-05-23 DU Preliminary BACT Comments_Final.pdf
2018-05-23 EPA Comments on ADEC Preliminary Draft SIP Dev.pdf
2018-09-13 ADEC BACT Comment Letter Fort Wainwright 09.13.18.pdf
2018-09-13 ADEC Request for Additional Information for Fort Wainwright BACT Analysis 091018.pdf
2019-05-10 Fort Wainwright Attachments OCR.pdf
2019-05-10 Public Notice Fort Wainwright BACT Determination.pdf
2019-07-26 Col. Christopher Ruga e-mail Serious SIP Comments from Fort Wainwright (UNCLASSIFIED).pdf
2019-07-26 Doyon Utilities Serious SIP BACT Analysis Comments [CO 19-067].pdf
2019-07-26 Isaac Jackson e-mail Doyon Utilities Serious SIP BACT Analysis Comments.pdf
2019-07-26 Mark Ingoglia e-mail USAF SIP Comments.pdf
2019-10-04 DU FWA Additional BACT Comments.pdf
2019-11-13 Final Fort Wainwright BACT Determination.pdf
2019-11-13 Fort Wainwright Response to Comments.pdf
Fairbanks PM-2.5 Serious SIP - Information Requ....pdf
RE_ [EXTERNAL] _Fairbanks PM-2.5 Serious SIP - ....pdf

The following documents are included as part of the BACT determination, however due to their electronic nature, they may be found posted separately at: http://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-serious-sip/

2016 scr_cost_manual_spreadsheet_vf Ft Wainwright (Army).xlsm
2016 sncr_cost_manual_spreadsheet_vf Ft Wainwright (Army).xlsm
2017-06-07 Amerair Cost for 50 and 80 percent control sncr (Army).xlsx
2017-07-21 Calculations for Emissions for EPA Tech review (Army).xlsx
2018-02-09 Fort Wainwright Wet Scrubber Cost Analysis (Army).xlsx
2019-04-25 Fort Wainwright - SO2 Controls Economic Analyses (ADEC).xlsx
2019-11-13 Fort Wainwright - SO2 Controls Economic Analyses Final (ADEC).xlsx
2019-11-13 Fort Wainwright SCR Economic Analysis (ADEC).xlsm
2019-11-13 Fort Wainwright SNCR Economic Analysis (ADEC).xlsm

- University of Alaska Fairbanks (UAF) BACT Determination BACT Documents

2010-08 Sargent and Lundy SDA FGD Cost Development Methodology 2010.pdf
2010-08 Sargent and Lundy Wet FGD Cost Development Methodlology 2010.pdf
2013-03 DSI for SO2 Cost Control Development Methodology.pdf
2015-04-24 Voluntary BACT Analysis for UAF.pdf
2015-07 UAF BACT Protocol FINAL.pdf
2015-08-14 UAF BACT Protocol response 081415.pdf
2017-01 FINAL BACT Analysis for UAF Campus.pdf
2017-01 SCR Cost Development Methodology.pdf
2017-05-11 Serious SIP BACT due date email.pdf
2017-10-20 ADEC BACT Comment Letter to UAF.pdf
2017-10-20 ADEC Request for Additional Information for UAF BACT Analysis.pdf
2017-10-20 Voluntary BACT Analysis for UAF letter 042515.pdf
2017-11-04 EPA Comments on ADEC BACT Analysis for UAF.pdf
2017-12-21 UAF Response to EPA-ADEC BACT Comments.pdf
2017-12-21 UAF Response to EPA-ADEC comments on BACT Analysis.pdf
2018-09-13 ADEC Request for Additional Information for UAF BACT Analysis 091018.pdf
2018-09-13 BACT Comment Letter to UAF.pdf
2018-09-13 EPA Comments on ADEC Preliminary Draft SIP Dev.pdf
2018-09-13 Request for Additional Information for the BACT Technical Memorandum for UAF.pdf
2018-11-01 UAF response to ADEC BACT Information Request.pdf
2019-04-23 UAF Response to BACT-SO2 Emissions.pdf
2019-04-29 UAF Response to BACT-SO2 Emissions.pdf
2019-05-10 UAF Attachments OCR.pdf
2019-05-10 UAF BACT Determination.pdf
2019-07-26 Frances Isgrigg e-mail UAF Serious SIP Comments 7-26-19.pdf
2019-07-26 Kerynn Fisher e-mail UAF comments - Fairbanks PM2.5 - Draft SIP 7-26-19.pdf
2019-11-13 Final UAF BACT Determination.pdf
2019-11-13 Final UAF Response To Comments.pdf

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2017-01-24 UAF_BACT_NOx_Tables_3-X (UAF).xlsx
2017-02-08 UAF_BACT_PM2.5_Tables_4-X (UAF).xlsx
2017-02-08 UAF_BACT_Tables_1-2_thru_1-5_and_Summary (UAF).xlsx
2018-11-20 UAF_BACT_SO2_Tables_5-X (UAF).xlsx
2019-11-13 UAF EU3 LNB Economic Analysis (ADEC).xlsx
2019-11-13 UAF EU3 SCR Economic Analysis (ADEC).xlsx
2019-11-13 UAF SCR Economic Analysis (ADEC).xlsm
2019-11-13 UAF SNCR Economic Analysis (ADEC).xlsm
2019-11-13 UAF SO2 Controls Economic Analyses (ADEC).xlsx

- Golden Valley Electric Technology Determination (GVEA) North Pole and Zehnder Facility BACT Documents

2017-11-16 ADEC BACT Comment Letter to GVEA.pdf
2017-11-16 ADEC Request for Additional Information for North Pole and Zehnder Facilities BACT Analyses.pdf
2017-11-16 EPA Comments on GVEA NP and ZND BACT 111517.pdf
2017-11-16 Voluntary BACT GVEA NP and Z letter 042415.pdf
2017-12-22 EPA_453_R-93-007.pdf
2017-12-22 GVEA Response to IR with attachments.pdf
2017-12-22 GVEA Response to IR.pdf
2018-09-13 ADEC BACT Comment Letter to GVEA.pdf
2018-09-13 ADEC Request for Additional Information for North Pole and Zehnder Facilities BACT Analyses 2 091018.pdf
2018-09-13 EPA Comments on ADEC Preliminary Draft SIP Dev 052118.pdf
2018-11-28 _GVEA_AltBact.pdf
2018-11-28 _GVEA_AltBACT_Attachments.pdf
2018-11-28 GVEA Alt BACT with attachments.pdf
2019-05-10 GVEA Attachments.pdf
2019-05-10 GVEA North Pole Attachments.pdf
2019-05-10 Public Notice North Pole BACT Determination.pdf
2019-05-10 Public Notice Zehnder BACT Determination.pdf
2019-11-13 Final North Pole BACT Determination.pdf
2019-11-13 Final Zehnder BACT Determination.pdf
2019-11-13 GVEA North Pole and Zehnder Response to Comments.pdf

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2017-08-27 North Pole - Section 4 - PM_F (GVEA).XLSX
2017-12-12 North Pole - Section 1 - PTE_F (GVEA).xlsx
2017-12-12 North Pole - Section 3 - NOx_F (GVEA).xlsx
2017-12-12 North Pole - Section 5 - SO2_F (GVEA).xlsx
2017-12-12 Zehnder - Section 1 PTE_F (GVEA).xlsx
2017-12-12 Zehnder - Section 3 NOx_F (GVEA).xlsx
2017-12-12 Zehnder - Section 4 PM_F (GVEA).xlsx
2017-12-12 Zehnder - Section 5 SO2_F (GVEA).xlsx
2018-11-26 A01_North Pole - Section 1 - PTE_F_181121_(GVEA).xlsx
2018-11-26 A04_FuelPrices_1810 (GVEA).xlsx
2018-11-26 A05a_North Pole - Section 5 - SO2_F_181121_ADEC_(GVEA).xlsm
2018-11-26 A05b_Zehnder - Section 5 - SO2_F_181121_ADEC_(GVEA).xlsx
2019-11-13 North Pole - Section 3 - NOx_F (ADEC).xlsx
2019-11-13 North Pole - Section 4 - PM_F (ADEC).xlsx
2019-11-13 North Pole Power Plant SO2 Controls Economic Analysis (ADEC).xlsx
2019-11-13 Zehnder Power Plant SO2 Controls Economic Analysis (ADEC).xlsx
2019-11-13 Zehnder SCR+Water Injection Economic Analysis (ADEC).xlsx

- Aurora Chena Aurora BACT Documents

1990-08 NSPS ICI SO2 RE.pdf

2017-03 Aurora BACT Report.pdf

2017-11-16 ADEC BACT Comment Letter to Aurora.pdf

2017-11-16 ADEC Request for Additional Information for Chena Power Plant BACT Analysis.pdf

2017-11-16 EPA Comments on Aurora BACT 111517.pdf

2017-11-16 Voluntary BACT Analysis Letter Aurora 042415.pdf

2017-12-22 Aurora Response to ADEC BACT Information Request 1.pdf

2017-12-22 ERM Final BACT Addendum for Aurora.pdf

2018-09-10 ADEC Request for Additional Information for Chena Power Plant BACT Analysis.pdf

2018-09-13 ADEC BACT Comment Letter to Aurora.pdf

2018-09-13 EPA Comments on ADEC BACT Analysis for Aurora 052118.pdf

2018-11-01 Aurora BACT Proposal No. 1899-R1.pdf

2018-11-01 Aurora General Arrangement Photo.pdf

2018-11-01 Aurora Preliminary Opinion of Probable Cost with attachments.pdf

2018-11-01 Aurora Preliminary Opinion of Probable Cost.pdf

2018-11-01 Aurora Response to ADEC BACT Information Request 2 with enclosures.pdf

2018-11-01 Aurora Response to ADEC BACT Information Request 2.pdf

2018-11-01 Aurora_DSI_Opinion_of_Probable_Cost_rev0.pdf

2018-11-01 CDS v SDA Cost Comparison for Aurora.pdf

2018-11-01 ICI Boilers 20081118 final_revised-Jan2009.pdf

2018-11-01 NSPS ICI SO2 RE.pdf

2018-11-01 ufc_3_701_01_c1_2018.pdf

2018-11-19 Aurora Proposed BACT Alternative with Appendices.pdf

2018-11-19 Aurora Proposed BACT Alternative.pdf

2019-05-10 Appendix A.pdf

2019-05-10 Appendix B.pdf

2019-05-10 Appendix C.pdf

2019-05-10 Appendix D.pdf

2019-05-10 Aurora Attachments OCR.pdf

2019-05-10 Public Notice Chena BACT Determination.pdf

2019-07-26 AE Comments on Draft SIP.pdf

2019-07-26 BACT Analysis Addendum - Ind Eng Eval_Final_20.pdf

2019-07-26 David Fish e-mail Aurora Energy, LLC's Comments on Draft SIP.pdf

2019-07-26 David Fish e-mail Usibelli Coal Mine, Inc. Comments on Draft.pdf

2019-07-26 UCM Comments on Draft SIP.pdf

2019-11-13 Chena Power Plant Response to Comments.pdf

2019-11-13 Final Chena BACT Determination.pdf

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2017-03 Aurora NOx cost calcs FINAL.XLSX
2017-03 SO2 cost calcs - LSFO - CUECOST3.xlsx
2017-12-22 FINAL-CUECost Calculator.xlsx
2017-12-22 FINAL-DSI Cost Calculator.xlsx
2019-11-13 Chena SCR Economic Analysis ADEC.xlsm
2019-11-13 Chena SNCR Economic Analysis ADEC.xlsm
2019-11-13 Chena SO2 Controls Economic Analyses.xlsx

Fairbanks North Star Borough Evaluation of Electrostatic Precipitators as Retrofit Devices

- Formation Mechanisms and Physical Properties of Particles from Wood Combustion for Design and Operation of Electrostatic Precipitators
- 2-Year Field Monitoring of Electrostatic Precipitators for Residential Wood Heating Systems
- Weston Solutions OekoTube Test Report
- Report on Testing of an Installation of Type "OekoTube OT-2" for Removing Dust from Flue Gases of Domestic Stoves
- Fairbanks North Star Borough Ordinance No. 2018-20-1G Appropriating $458,000 from General Fund Balance to the Transit Enterprise Projects Fund for Wood Stove/Pellet Stove Retrofit Emissions Control Device Testing

Fairbanks North Star Borough Ordinances

- Fairbanks North Star Borough Ordinance No. 2015-01 An Ordinance Amending Chapter 8.21 of the FNSB Code of Ordinances Regarding the PM2.5 Air Quality Control Program, Amending 2.48.120 regarding the Air Pollution Control Commission's Duties, and Amending 1.04.050 Regarding the Fine Schedule to Add Violations of the PM2.5 Air Quality Control Program
- Fairbanks North Star Borough Ordinance No. 2016-21 An Ordinance Amending FNSB 8.21.025 to Require the Removal of Certain Unlisted Hydronic Heaters in the Air Quality Control Zone, Amending the FY 2015-16 Budget by Appropriating $500,000 from the General Fund Fund Balance to the Transit Enterprise Projects Fund to Pay for the Removal of the Unlisted Hydronic Heaters and Suspend all Other Payments from the Voluntary Removal and Replacement Program until May 1, 2017
- Fairbanks North Star Borough Ordinance No. 2016-37 An Ordinance Amending Title 21

Regarding No Oher Adequate Source of Heat Determinations

- Fairbanks North Star Borough Ordinance No. 2017-18 An Ordinance Amending Chapter 21.28 FNSBC regarding the PM2.5 Air Quality Control Program and Amending FNSBC 1.20.080, Fine Schedule

- Fairbanks North Star Borough Ordinance No. 2017-44 An Ordinance Amending Chapter 21.28 FNSBC Regarding the PM2.5 Air Quality Control Program, Amending Title 4 Regarding Air Pollution Control Commission Duties, Amending FNSBC 1.20.080, Fine Schedule, and Amending Appendix E – User Fee Schedule/Transportation of Ordinance No. 2017-20 (FY 2017-18) to Add Permit Application Fees for Solid Fuel Burning Appliance in New Construction

- Fairbanks North Star Borough Ordinance No. 2018-04 An Ordinance Amending Chapter 21.28 FNSBC Regarding Criteria for No Other Adequate Source of Heat Determinations and Amending Borough Listed Appliances

- Fairbanks North Star Borough Ordinance No. 2018-26 An Ordinance Amending Chapter 21.28 FNSBC to Add Definitions and Standards for Retrofit Control Devices, Including Electrostatic Precipitators

- Fairbanks North Star Borough Ordinance No. 2018-45 An Ordinance Amending Chapter 21.28 FNSBC Regarding Air Quality Control Program, FNSBC 1.20.080 Fine Schedule, and Chapter 4.12 FNSBC Regarding Air Pollution Control Commission

Evidence of Implementation of Moderate SIP control Measures.

Under the PM2.5 Implementation Rule, 40 CFR 51.1005(b)(1)(ii), the State is required to show evidence of implementation of all control measures submitted in the applicable plan.[1] Table 7.7-1 in the Serious SIP Section III.D.7.7.3 summarizes the Moderate SIP control measures and their implementation status. The detailed information on the implementation of the Moderate SIP control measures with the status is explained in this appendix document.

7.7.3.1 Solid Fuel-Fired Heating Device Upgrades

Solid fuel-fired heating device upgrades, also called the Wood Stove Change-Out Program (WSCOP) or Fairbanks North Star Borough (FNSB) Enhanced Voluntary Removal, Replacement & Repair Program, is a voluntary incentivized control measure aimed at upgrading or removing solid fuel-fired heating devices to provide immediate and long-term reductions of $PM_{2.5}$ emissions in the nonattainment area. The program, which was started in 2010 and still ongoing, is reinforced with funds from the Targeted Air Shed (TAS) Grants.

Although the Borough suspended the wood stove change-out program because of the passage of the Voter Proposition 4 on October 2, 2018, the program was reinstated after making necessary changes to the Borough's code. The wood stove change-out program includes requirements that are more stringent than the Alaska Department of Environmental Conservation (DEC) standards. However, they only apply to the Borough's air quality control zone. Borough ordinance 2015-73, adopted January 14, 2016, limits the change-out program to the air quality control zone and sets emission limits for solid fuel-fired heating devices installed as part of the change out program. Borough ordinance 2017-44, adopted June 19, 2017, requires that a Borough listed vendor/installer properly installs a qualified appliance. The ordinance requires that wood and pellet stoves must be EPA-certified with an annual average $PM_{2.5}$ emission rating of 2.0 grams per hour or less. Hydronic heaters must be pellet-fired, EPA-certified, and have an emission rate of 0.10 pounds per million BTU or less.[2] These emission standards are designed to adopt EPA's wood-fired heater New Source Performance Standards (NSPS) 2020 emission limits early for devices installed as part of the change out program.

Also, in order to ensure that replacements of wood-fired heaters are moving the solid fuel-fired devices within the Fairbanks nonattainment area toward the NSPS 2020 emission limits, the terms and conditions of the Targeted Air Shed Grant, as stated in the work plan, require an average emission level of 0.10 pounds per million BTU and particulate matter annual average emission limit of 2.0 grams per hour.[3] Tables 7.7.3-1 and 7.7.3-2 display the eligible devices for replacements and replacement options and emission limits respectively.

Table 7.7.3-1. Eligible Devices and Replacements

[1] 40 CFR 51.1005

[2] Fairbanks North Star Borough Ordinance No. 2017-44, adopted June 19, 2017

[3] FY-16 TAS Work Plan

Device Type	Eligibility Requirement		Replacement Option
Hydronic Heater	All Wood or Coal Hydronic Heaters		1,2,3,4,5,6,7,8
Wood or Coal Stove	Non EPA-Certified	EPA-Certified ≥ 2.5 g/hr (new device must also be less than half of old device emission rating)	1,2,4,5,6,7,8
	EPA-Certified Wood Stove (Repair)		9,10
Fireplace	All Fireplaces		1,2,3,4,5,6,7,8

Table 7.7.3-2 Replacement Options and Emission Limits

Replacement Option			Emission Limit
1	EPA-Certified	Catalyst – Equipped Wood Stove or Catalyst-Equipped Insert	≤ 2.0 g/hr
2		Pellet Stove or Insert	
3		Pellet Hydronic Heater	≤ 0.10 lbs/mmBtu
4	Home Heating Oil Heater		
5	Hot Water District Heat		
6	Electric Heater		
7	Natural Gas Device		
8	Propane Device		
9	Catalytic Converter Repair		
10	Other Emission Reduction System Component Repair		

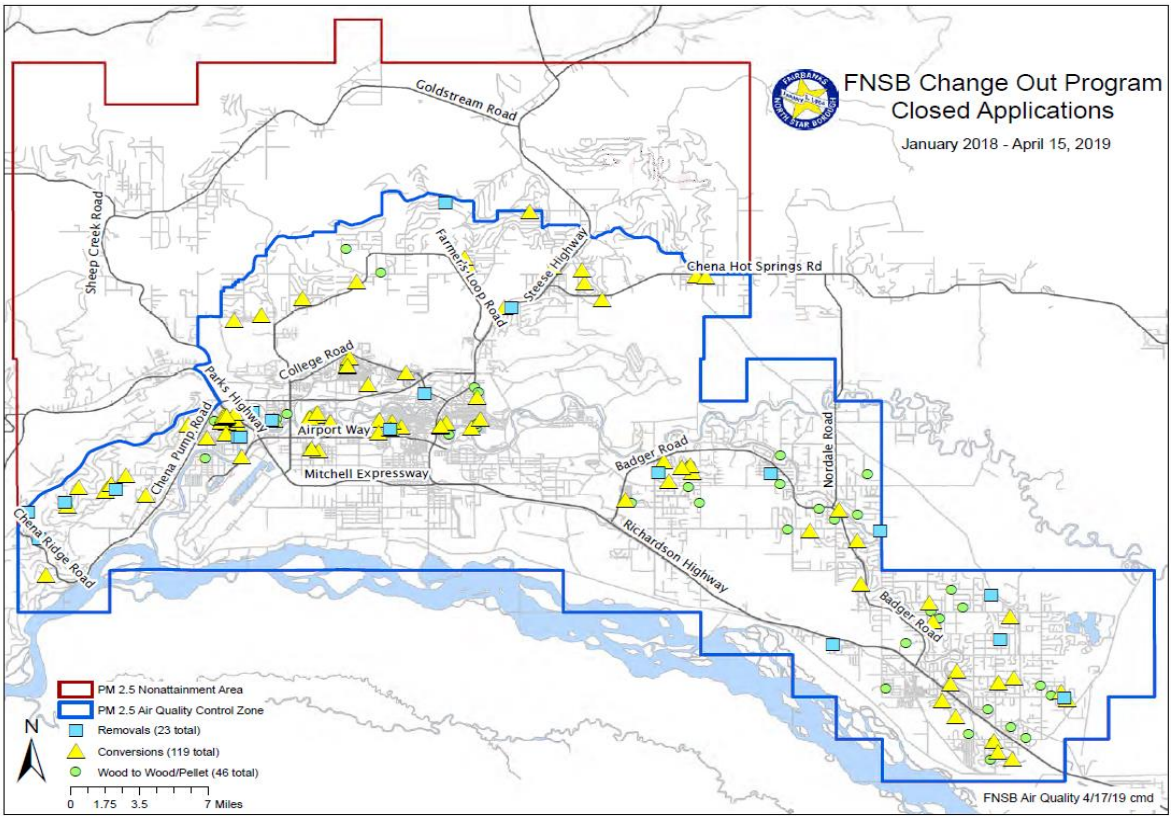
To date, a total of 164 change outs have been completed with funds from the FY-16 TAS and FY-17 TAS; 163 change outs from the FY-16, and one change out from the FY-17.[4,5,6] However, as of March 31, 2019, as displayed in Table 7.7.3-1, a total of 2,636 change outs out of the 2,760 change-outs required by the Moderate Area SIP have been completed. Figure 7.7.3-3 provides a map of the locations of change outs or heater removals throughout the nonattainment area from January 2018 through April 15, 2019.

Table 7.7.3-3. Woodstove Change-Out Statistics

Woodstove Change Out Statistics (as of 3/31/2019)		
Device Type	**Total Devices Removed, Replaced, or Repaired**	**Percentage of Total Change outs**
Replace Solid Fuel Burning Device	1925	73.0%
Replace Hydronic Heater (HH)	86	3.3%
Removal of SFBA (not replaced)	237	9.0%
Removal of Hydronic Heater (not replaced)	110	4.2%
Repairs to EPA certified Devices	75	2.8%
Fireplace Replacements	203	7.7%

Figure 7.7.3-1. Map of the locations of change outs or heater removals throughout the nonattainment area.

[4] Wood Stove Change Out Program 2018-2019 Brief Statistics
[5] FY-16 TAS-01 2019 1st Quarter Report
[6] FY-17 TAS-01 2019 1st Quarter Report



7.7.3.2 Solid Fuel-Fired Heating Device Emission Standards

In order to provide support for the WSCOP and ensure commitments to the Moderate Area SIP control measure, the State, in 2014, adopted a new regulation that requires all the new wood-fired heating devices being installed in the Fairbanks nonattainment area to meet emission standards (Table 7.7.3-4) that are more stringent than the 1988 EPA New Performance Standards (NSPS).[7]

Table 7.7.3-4. DEC Emission Standards for Wood-Fired Heating Devices in the Fairbanks Nonattainment Area

Device Type	$PM_{2.5}$ Emission Standard
Woodstoves	2.5 grams/hour
Wood Hydronic Heaters	2.5 grams/hour
Wood Heating Appliances Greater than 350,000 btu/hr heat output	2.5 grams/hour

The Borough's change out requirements (Table 7.7.3-5) mirrors the EPA's wood-fired heater NSPS 2020 emission limits. However, for home heating device installations that are not part of the change out program, the Borough requirements were that all the solid fuel-fired appliances be EPA-certified and have an annual average emission rating of 2.5 grams per hour or less or 0.10

[7] 18 AAC 50.077

pounds per million BTU for hydronic heaters. However, since the removal of the Borough's authority, the State emission standards have continued to apply to solid fuel-fired heating devices in the Fairbanks nonattainment area to ensure the continued implementation of the Moderate SIP control measure. The requirements of the Targeted Airshed Grant for the Borough change out program continue to ensure that devices installed through the program meet levels mirroring the EPA's wood-fired heater NSPS 2020 emission certification limits.

Table 7.7.3-5. FNSB WSCOP Emission Standards for Wood-Fired Heating Devices

Device Type	$PM_{2.5}$ Emission Standard
Wood and Pellet stoves (EPA-certified)	2.0 grams/hour
Pellet-fired Hydronic Heaters (EPA-certified)	0.10 Ibs/mmBtu or less

7.7.3.3 Improving Solid Fuel-Fired Heating Device Operations

Improving the operations of solid fuel-fired heating devices was one of the voluntary measures identified in the Moderate SIP. To achieve this, the Borough and DEC developed a number of measures, including public education, incentives for the use of wood pellets or energy logs, regulations addressing visible emissions from stacks, and the use of appropriate fuels in solid fuel-fired heating devices. The extensive public outreach is intended to encourage residents to employ the best burning practices when using wood heating devices, protect themselves, and to reduce $PM_{2.5}$ emissions in Fairbanks nonattainment area. Examples of the public outreach include the ''Split, Stack, Store, & Save" campaign and the repealed Voluntary Burn Cessation Program (VBCP). The education outreach, which is tailored to the individual needs, is propagated through TV/YouTube ad topics, Radio ad topics, web-based outreach, print-based media, public presentations, events, and other outreach methods.

Some of the Borough's education outreach activities such as mass notification of alerts, electronic signs for air quality alerts, a notice of restrictions, and notifications of violations have since been discontinued due to the passage of Prop 4. However, the DEC programs and regulations that promote the use of correct fuels have continued to facilitate the implementation of the Moderate SIP control measure. To assure that wood heating devices are being operated properly, the DEC regulations in 18 AAC 50.075, as amended in 2017, requires a 20% opacity requirement for all solid-fuel fired heating devices.[8] This opacity requirement mirrors the FNSB ordinance in that the 20% opacity is for all operations except at startup. This standard reflects improvements in wood heating technology and the need to burn cleanly particularly during air quality episodes. If devices are operated improperly or with wet wood, dense smoke can be emitted from stacks. The opacity regulations for wood-fired heating devices assist DEC in responding to citizen complaints about smoky stacks in their neighborhoods and in addressing high emitting devices, particularly during periods of poor air quality.

[8] 18 AAC 50.075

Also, to further support the efforts to reduce emissions through the proper operation of solid fuel-fired devices inside the nonattainment area, the State regulation, 18 AAC 50.076, as amended through September 15, 2018, requires individuals to use the appropriate fuel (wood or coal) in their device and use of dry wood (20% moisture content or less) in the winter months.[9] Until the FNSB authority was removed in October 2, 2018, the Borough's ordinance, which was adopted on February 27, 2015, required the use of dry wood year round.

7.7.3.4 Reduced Use of Solid Fuel-Fired Heaters during Air Pollution Episodes

Until the passage of Prop 4 on October 2, 2018, FNSB worked together with DEC to forecast daily air quality during the winter and issue curtailment of the use of wood-fired heating devices in the Fairbanks nonattainment area on days projected to have poor dispersion and higher $PM_{2.5}$ concentrations. To enforce compliance with the control measure, the Borough, through the local media, notified the public of air alerts, why they were called, and provided residents with options. Table 7.7.3-6 below displays the FNSB air quality episode thresholds and exceptions.

Table 7.7.3-6. FNSB Air Quality Episode Thresholds and Exceptions

Episode Feature	Stage 1 Air Alert	Stage 2 Air Alert
$PM_{2.5}$ Threshold, micrograms per cubic meter, ($\mu g/m^3$)	25	35
Exceptions During a Power Outage	Yes	Yes

In its code the Borough allowed property owners or managers to obtain a "No Other Adequate Source of Heat" (NOASH) waiver to all stages of burn cessation requirements if the property relies on a solid fuel-fired heating device as its sole source of heat, or if compliance with the burn restrictions would result in property damage, or that economic hardships required the applicant's use of a solid fuel-fired heating device. Applicants were only eligible for a NOASH if the solid fuel-fired heating device was borough listed. Ordinance 2016-37 strengthened the NOASH by limiting the waiver eligibility to properties constructed before December 31, 2016, to ensure no new construction occurs that would be eligible for a NOASH waiver. Ordinance 2017-18 further strengthened the curtailment program by replacing the three stage system with a two stage curtailment. The voluntary curtailment was discontinued and mandatory curtailments were lowered from 55 □g/m^3 to 35 □g/m^3 (Stage 2) and 35 □g/m^3 to 25 □g/m^3 (Stage 1). Ordinance 2017-18 also removed the temperature exemption of -15^{O}F as recorded at the Fairbanks International Airport. Ordinance 2017-44 further strengthened the curtailment program by requiring a Stage 1 Waiver to be obtained by a property owner or manager who verifies that the solid fuel burning appliance (SFBA) operated during a Stage 1 air alert is a borough listed appliance, thereby making Stage 1 curtailments enforceable. NOASH and Stage 1 waiver applicants were also urged to participate in the Borough's change-out program to help reduce emissions.

[9] 18 AAC 50.076

Also, FNSB used the Voluntary Burn Cessation Program (VBCP) until it was repealed in 2017 to encourage, incentivize, and facilitate the voluntary cessation of the use of wood burning appliances in the nonattainment area during air quality episodes. The Borough conducted the VBCP through five separate components; an Alert System, Social Media, Public Awareness, Marketing, and Incentive program.

Table 7.7.3-7 displays the number of Stage restriction called by FNSB for the 2017/2018 heating season. A restriction day is defined as a 24-hour period during which the area was under a stage restriction for more than 12 hours, e.g. if a Stage 2 was in effect from 4:00 pm Monday through 4:00 pm on Wednesday then the event would be logged as two restriction days (Tuesday and Wednesday would count). Restrictions warranted were based on the real-time BAM data for each respective area, and if the BAM data indicated a 24-hour average was above the threshold for a Stage 1 or a Stage 2 then the day was logged as warranted. The Borough issued a total number of 244 Stage 1 waivers and 125 NOASH waivers for 2017/2018 heating season. As shown in Table 7.7.3-8, there were 105 observed violations for Stage 1 for which 90 warning letters were sent while for Stage 2, there were 137 violations for which 111 warning letters were sent.[10] After the first warning letter sent, the FNSB Mayor's office would make personal contact with the letter recipient. Repeat violations would result in a second warning letter, and a third violation would result in issuance of a citation. A total of two citations were issued during the winter of 2017/2018, one for a Stage 1 violation and one for a Stage 2 violation.

Table 7.7.3-7. Number of Stage restriction days called by FNSB during 2017/2018 heating Season

	Stage 2	Stage 1
North Pole		
Restriction Called	28	8
Restriction Warranted	41	9
Fairbanks		
Restriction Called	7	12
Restriction Warranted	5	9

Table 7.7.3-8 Number of observed violations and letters written by FNSB for Stage 1 and Stage during 2017/2018 heating season

	Stage 2	Stage 1
Observed Violations	137	105
Warning Letters	111	90

Following the removal of the Borough's authority to regulate wood stoves and other wood and coal-fired heating devices on October 2, 2018, DEC, by virtue of its regulation that was adopted

[10] http://fnsb.us/transportation/AQDocs/2018-07-16%20FNSB%20AQ%20Stakeholders.pdf

into the SIP on September 7, 2015, assumes the authority of calling air quality alerts, curtailment announcements, and conducting compliance and enforcement in the Fairbanks nonattainment area. DEC calls the alert or curtailment for the entire nonattainment area, or specific zones: North Pole Zone, Fairbanks Zone, or both depending on the available meteorological data, weather forecasts, affected area, the strength of the inversion, and potential duration of the inversion. Through outreach methods, which includes online sign-up electronic notification, local media outlets (TV, radio) and the Division's Air Quality Advisories web page at: http://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-curtail-alert/, DEC notifies the public about air quality alerts, episodes, and exemptions. Exemptions from a curtailment included in an announcement may consist of areas experiencing power outages and residents who have temporary waivers. Exceptions to individual episodes may also include exceptions based on the class or type of device or based on a device's particulate emission rates.

Table 7.7.3-9 displays the number of alert restrictions called by the Alaska Department of Environmental Conservation for the 2018/2019 heating season. As shown in Table 7.7.3-10, DEC issued 27 NOASH waivers and honored 34 FNSB NOASH waivers and 244 FNSB Stage 1 waivers (which were issued on or before October 25, 2018). Unlike the Borough, the State regulation only permits DEC to issue temporary waivers. During the 2018/2019 heating season, DEC used two field staff and four post processing staff for compliance and enforcement, spent a total of 17 days for surveillance, and ended up with 184 unique addresses. A total of 38 complaints were received from the public during the curtailment alerts.

Table 7.7.3-9. Number of Stage restrictions called by DEC during 2018/2019 heating season

Number of Alert Restrictions Called	Stage 1	Stage 2
North Pole:	12	19
Fairbanks:	14	1
Total:	26	20

Table 7.7.3-10. Burn restriction waivers issued by DEC during 2018/2019 heating season

Burn Restriction Waivers Issued	
DEC NOASH Waivers:	27
FNSB NOASH Waivers (honored by DEC):	34
FNSB Stage 1 Wavers (honored by DEC):	244
Total:	305

For the 2018/2019 heating season, as displayed in Table 7.7.3-11, there were 40 observed violations for Stage 1 for which DEC sent 30 advisory/compliance letters while for Stage 2, there were 199 violations for which 167 letters were sent. Post processing of observations is conducted by DEC staff, which may result in staff finding that a letter or action is not required (such as identification of a NOASH household or an oil heater stack that was mistaken for a solid-fuel heater stack).

Table 7.7.3-11. Number of Stage violations and advisory/compliance written by DEC 2018/2019 heating season

Violations of Alert Restrictions	Stage 1	Stage 2
Observed:	40	199
Advisory/Compliance Letters Sent:	30	167

The FNSB air quality code was modified and strengthened through many ordinances. For the 2017/2018 heating season FNSB had the following regulations, in addition to the curtailment program, aimed at reducing $PM_{2.5}$ pollution:

21.28.030 (A) Installation of an unlisted appliance. Installation of Certain Solid Fuel Burning Appliances in the Nonattainment Area. Within the nonattainment area no person shall install or allow the installation of a solid fuel burning appliance unless it is listed by the borough as qualifying under this chapter and the installation complies with all other requirements imposed in this chapter. It is a separate violation to fail to remove a solid fuel burning appliance installed in violation of this chapter.

21.28.030 (B) Failure to remove, using or operating a prohibited hydronic heater. No person who has been convicted of or pled no contest to two or more violations of this chapter involving visible emissions or emissions crossing property lines shall, in the air quality control zone, operate, use or keep installed a hydronic heater unless the hydronic heater is:

1. Borough listed or was listed at the time of installation,
2. A closed combustion system with automatic components that feed solid fuel, including wood pellets, into a firebox where the combustion is enhanced by an active airflow system, or
3. Connected to a thermal mass system that is certified by the contractor or installer as sufficient to allow the hydronic heater to burn at maximum capacity minimizing on/off cycling. The division may require an owner to provide documentation supporting the certification.

21.28.030 (C) Violation of visible emissions standard. No person shall cause, permit, or allow particulate emissions from a non-mobile source in the air quality control zone to create opacity greater than 20 percent for a period or periods aggregating more than 10 minutes in any hour except during the first 40 minutes after the initial firing when the opacity limit shall be less than 50 percent.

21.28.030 (D) Emissions crossing property lines. $PM_{2.5}$ Emissions Crossing Property Lines. No person shall cause or permit particulate emissions from a non-mobile source to impact the resident(s) of a neighboring property through the creation of an emissions plume that:

1. Crosses a property line;
2. Is observable using EPA Method 22 (40 CFR 60 Appendix A); and
3. Is 25 µg/m3 greater than the surrounding immediate vicinity background $PM_{2.5}$ level using methods defined by the borough division of air quality. For purposes of this subsection, the surrounding "immediate vicinity" means land within an area measured 1,200 feet in all directions from the boundaries of the emitting property.

21.28.030 (E) Failure to obtain, submit and execute a permit for installing a SFBA in new construction. For all new construction that commences on or after January 1, 2018, and is located within the air quality control zone the following will apply:

a. Installation of a solid fuel burning appliance is prohibited unless a permit has been issued by the division. A permit must be obtained for any solid fuel burning appliance installed in new construction prior to installation of the appliance.

21.28.030 (F) Illegal installation of hydronic heaters. Unless permitted by a variance, or if replacing an existing hydronic heater with a listed appliance, no person shall install or allow the installation of a hydronic heater located less than:

a. Three hundred thirty feet from the closest property line; or
b. Six hundred sixty feet from a school, clinic, hospital, or senior housing unit.

21.28.030 (G) Use of prohibited fuels. No person shall burn in the borough any fuel, except coal in an appliance designed to use coal, which is not listed in the manufacturer's owner's manual as an acceptable fuel for that device or any of the following items in a solid fuel burning appliance:

1. Any wood that does not meet the definition of clean wood or has more than 20 percent moisture content;
2. Garbage;
3. Tires;
4. Materials containing plastic or rubber;
5. Waste petroleum products;
6. Paints and paint thinners;
7. Chemicals;
8. Glossy or colored papers;
9. Construction and demolition debris;
10. Plywood;
11. Particleboard;
12. Saltwater driftwood
13. Manure;
14. Animal carcasses;
15. Asphalt products;
16. Flooring products.

21.28.030 (H) Violation of commercial sale requirements. No person shall sell or lease an unlisted solid fuel burning appliance or barrel stove kit in the borough unless the buyer signs an affidavit, on a form prescribed by the borough, attesting that the appliance will not be installed or used in the air quality control zone. This section does not apply to appliances or stoves that transfer pursuant to a sale of property;
2. No person shall commercially sell or offer for sale or lease a solid fuel burning appliance in the borough unless the commercial seller or dealer provides the prospective buyer or lessee, prior

to any sales or lease agreement, with a written notice, prepared or approved by the division, that includes, but is not limited to, the following:

a. The fuel restrictions imposed in this chapter;
b. Proper installation, property location, operation, and maintenance of the appliance;
c. An advisory statement noting that operation of solid fuel burning appliances may not be appropriate in some areas due to terrain, meteorological conditions, or other relevant conditions that render the operation of the appliance a public nuisance or health hazard even though it is otherwise legally installed and operated.

21.28.060 Filing a false affidavit. It shall be a violation to submit a false affidavit for a "no other adequate source of heat" determination.

FNSB compliance and enforcement efforts for the 2017/2018 season recorded a total of 205 violations, a breakout is provided in Table 7.7.3-12

Table 7.7.3-12. Number of observed violations by FNSB during 2017/2018 heating season

Code Provision	Number of Violations
21.28.030 (A) Installation of an unlisted appliance	0
21.28.030 (B) Failure to remove, using or operating a prohibited hydronic heater	0
21.28.030 (C) **Violation of visible emissions standard**	**1**
21.28.030 (D) **Emissions crossing property lines**	**9**
21.28.030 (E) Failure to obtain, submit and execute a permit for installing a SFBA in new construction	0
21.28.030 (F) Illegal installation of hydronic heaters	0
21.28.030 (G) Use of prohibited fuels	0
21.28.030 (H) Violation of commercial sale requirements	0
21.28.050 (C) **Violation of Stage 1 air alert**	**90**
21.28.050 (D) **Violation of a Stage 2 air alert**	**105**
21.28.060 Filing a false affidavit	0

7.7.3.5 AHFC Energy Programs

The Alaska Housing Finance Corporation (AHFC) implements several energy programs that are designed to make homes more energy efficient.[11] Since adopting the Energy programs as a voluntary measure under the Moderate SIP, they have continued to be implemented in the Fairbanks nonattainment area. As homeowners make energy efficiency improvements, they reduce the amount of fuel and electricity needed for power and heat leading to corresponding air quality benefits due to the reduced fuels being burned for space heating and power generation.

Under the AHFC Home Energy Rebate Program, home owners may receive up to $10,000 for making energy-efficient improvements to their existing home based on before and after energy ratings made by Energy Raters. Homeowners must get an initial energy rating and apply for the program. Eighteen months is provided to complete improvements with a second energy rating after the improvements are done. Homeowners are reimbursed (up to a specified amount) for the energy ratings and receive a rebate based on their home's improved energy-efficiency and eligible receipts. Only those improvements recommended by the rater are eligible for the rebate.

There is also a Home Rebate Program that provides a $10,000 rebate for 6 Star homes and $7,000 for 5 Star Plus homes (the highest AHFC energy rating categories). In addition, AHFC offers interest rate reductions when individuals finance new or existing energy efficient home when borrowers purchase and make energy improvements to an existing home. Any property that can be energy rated and is otherwise eligible for AHFC financing may qualify for the energy efficiency interest rate reduction program.

Individuals who meet income limits are eligible to apply for the AHFC Weatherization Assistance Program. Local weatherization providers provide program services at no cost to qualified homeowners and renters including single and multifamily homes, mobile homes, apartments, and condominiums. The Weatherization Assistance Program provides low- and moderate-income households with improvements to their homes which increase the energy efficiency of their dwelling, including measures such as:

- Air sealing attics, crawlspaces, etc.
- Insulating and weather stripping
- Repair and replacement of heating systems
- Replacement of doors and windows
- Installation of fans, smoke alarms, CO detectors

7.7.3.6 Expanded Availability and Use of Natural Gas

The State of Alaska is actively working towards expanding the availability and use of natural gas in the Fairbanks nonattainment area through the implementation of the Interior Energy Project. A key to reducing fine particulate matter air pollution in the Fairbanks nonattainment area in the long term, as identified in the Moderate SIP, is expanding the availability of affordable, cleaner burning fuel options within the nonattainment area. In April 2013, the Alaska Legislature

[11] https://www.ahfc.us/about-us

unanimously passed the Senate Bill 23 which established the Interior Energy Project. The legislation authorizes the Alaska Industrial Development and Export Authority (AIDEA) to provide the financing package to partner with the private sector to build a liquefied natural gas (LNG) plant and natural gas heating distribution system in Fairbanks and the North Pole. The current projections indicate that the earliest this project will provide additional natural gas into the community is 2020.

7.7.3.7 Required Replacement of Non-Certified Wood Heating Devices When Properties are Sold

Section 172(c)(9) of the CAA requires nonattainment plans to "provide for the implementation of specific measures to be undertaken if the area fails to make reasonable further progress, or to attain the national primary ambient air quality standard by the (applicable) attainment date . . . ." As such, due to the reclassification of the Fairbanks nonattainment area to a Serious nonattainment area, effective June 9, 2017, the contingency measure in 18 AAC 50.077 requires older wood-fired heating devices to be replaced upon the sale of a property. The contingency measure also provides the ability for limited temporary waivers.

These limited waivers, which may be granted on a case by case basis, depend on the following factors:

- Financial hardship information provided by the owner or operator;
- Technical feasibility information provided by the owner or operator;
- Potential impact to locations with populations sensitive to exposure to $PM_{2.5}$ including hospitals, schools, child care facilities, health clinics, long-term care facilities, assisted living homes, and senior centers.

DEC regulations in 18 AAC 50.077 and 18 AAC 50.079 (as amended through September 2018) require solid fuel-fired heating devices including wood stoves, pellet stoves, coal stoves and hydronic heaters, to be removed from a property before sale, lease, or conveyance in the Fairbanks North Star Borough $PM_{2.5}$ nonattainment area unless they are EPA-certified (wood and pellet stoves), have a qualifying Phase 2 "White Tag" (hydronic heaters), or meet current emission standards.[12,13] The regulations apply to devices located anywhere on the property including inside the home, in a garage, and in outbuildings.

To facilitate the continued implementation of the contingency measure, DEC organizes outreach programs, which include presentation and Q&A sessions, to educate real estate professionals and vendors in the Fairbanks nonattainment area. Initial contacts began in May 2016 with 1400 letters sent to real estate professionals. A dedicated webpage at: http://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-real-estate/ has been developed to provide information. As displayed in Table 7.7.3-13 below, since the triggering of the contingency measure, six outreach letters have thus far been sent to each of the real estate professionals and vendors while seven outreach presentations have been conducted. While real-

[12] 18 AAC 50.077
[13] 18 AAC 50.079

estate professionals are contacted by DEC about three times per week, solid-fuel device vendors are contacted about two times per year. DEC updates the EPA device list once per month, and thus far, there have been seven real-estate investigations for noncompliance.

Table 7.7.3-13. Contingency Measure Requiring Replacement of Older Wood Heating Devices When Properties Are Sold

Number of Outreach letters sent to real-estate professionals, vendors etc.	6
Outreach (presentations, Q&A) to real-estate professionals, vendors etc.	7
Average weekly Real-estate contacts	3
Updated ADEC Maintained EPA device list	Once per month (when applicable)
Number of real-estate investigations for noncompliance	7
Regular contact with solid fuel device vendors	Twice per year

7.7.3.8 Enhanced Dry Wood Compliance: Registration of Wood Sellers and Moisture Content Disclosure (Contingency Measure)

The registration of wood sellers and moisture content disclosure was initially implemented as a voluntary measure and then triggered as a regulatory contingency measure upon the reclassification of the Fairbanks nonattainment area to a Serious nonattainment area effective June 9, 2017. DEC regulations in 18 AAC 50.076, as amended through September 15, 2018, require that commercial wood sellers register with the State before selling or providing wood to a person located in the Fairbanks nonattainment area. Also, the provisions in the regulations require that registered wood sellers use a DEC-approved moisture test meter to test the moisture content of a load of wood at the time of sale, provision, or delivery to the consumer.

The requirements for testing the moisture content of split wood, wood rounds or logs that are cut at the time of or before the sale and that are marketed, sold or provided as dry wood are stipulated in the regulations. DEC requires that the registered wood sellers document the measured moisture content on the moisture content disclosure form that the department provides, and obtain the consumer's signature or mark unavailable if the customer is not available. The State's Moisture Disclosure Program requires wood sellers to register and provide wood moisture content information to buyers. While the publishing of information on vendors that sell dry wood is increasing the awareness of burning only dry wood in both newer and older wood-fired heating devices, the tracking of moisture content of wood sold, as well as number of the cords of wood sold, is helping to monitor the progress of the contingency measure.

Currently, as shown in Table 7.7.3-14 below, there are 18 registered wood sellers in the Fairbanks nonattainment area, among which are two dry wood sellers. To date, 2,407 forms have been received from the commercial wood sellers, and about 1593 cords of woods have been sold. On a monthly average, about 50 forms are received, and about 33 cords are sold. While larger wood sellers are visited once per month, smaller operators are visited less frequently.

Table 7.7.3-14. Registered Wood Sellers Statistics

Number of registered wood sellers (Fairbanks Nonattainment Area)	18 (2 recognized dry wood sellers)
Number of forms received to date	2407
Number of cords tracked to date	~ 1593
Average number of forms received per month	~ 50
Average number of tracked cords sold per month	~ 33
Frequency of site visits for moisture checks conducted	Approximately once a month for larger sellers and less frequently for smaller operators

7.7.3.9 Expanded Availability of Plug-Ins

Preheating vehicles, also called pugging-in, provides a substantial reduction in motor vehicle cold start emissions. As such, this transportation control strategy was made a voluntary measure and included in the Moderate SIP.

Public education is an important part of this control strategy. The Borough encourages residents to plug in their vehicles at temperatures up to 20^{o} above zero. Engine block heaters are considered an essential component of winter driving in Fairbanks. It is estimated that a significant number of vehicles will not start at temperatures of 20^{o} F below zero. Since –20^{o} F or colder temperatures are a frequent occurrence in winter, it was assumed that by encouraging motor vehicle operators to plug in at warmer temperatures, carbon monoxide and $PM_{2.5}$ emissions would be reduced without creating an onerous burden on residents, as they already have engine block heaters. Subsequent test programs conducted by DEC and the Borough confirmed the emission benefits of plugging-in at warmer temperatures. Television spots were produced to inform the public of the multiple benefits of plugging in at warmer temperatures. Although not scientific in nature, the messages were that plugging in:

1. Reduces engine wear, thus reducing vehicle maintenance costs;
2. Improves air quality;
3. Improves chances of complying with the federal Clean Air Act; and
4. Improves vehicle starting and reduces the idling time needed before driving.

Based on its historical success in implementing the plug-in program, the Borough continues public awareness as part of it implementation of an ordinance that requires owners of parking lots to provide power to electrical outlets for plug-ins at temperatures below 20^{o} F. In the past, four elementary schools within the $PM_{2.5}$ nonattainment area had been equipped with 193 plug-ins while 9,727 spaces of government and private areas within the Fairbank CO nonattainment area had been upgraded with 9,033 plug-ins. Also, as of 2013, two high schools within the

Fairbanks $PM_{2.5}$ nonattainment had been equipped with a total of 542 plug-ins using the Federal Highway Administration (FHWA) CMAQ funds. Table 7.7.3-15 below displays the most recent update (as of April 12, 2019 from FAST-Act) on the plug-in projects in the Fairbanks nonattainment area between 2015 and 2019.

Table 7.7.3-15. Additional Parking Lots Equipped with New Plug-ins from 2015-2019

Fairbanks Nonattainment Area Additional Parking Lots Equipped with New Plug-ins 2015-2019 (as of April 12, 2019)		
Facility	**New Plug-ins**	**Comments**
Carlson Center	600	To be completed on August 31, 2019
Big Dipper Ice Arena	300	To be completed on August 31, 2019
North Pole Library	25	Project completed
Fairbanks Library	50	Project completed
Total	975	

7.7.3.10 Mass Transit System

The Borough began operating the Metropolitan Area Commuter System (MACS) fixed route transit service in 1977. The MACS system is comprised of nine fixed routes in the cities of Fairbanks and North Pole, as well as other nearby communities. The MACS service operates Monday through Friday from 6:00 AM to 9:45 PM and limited routes on Saturday from 8:45 AM to 7:45 PM. There is no Sunday service.

The Borough also operates a door-to-door paratransit service, Van Tran, which began in 1988. The American Disabilities Act of 1990 (ADA) requires all public transit systems that provide fixed route bus and rail service to also provide an alternative transportation service (usually vans and small buses) for people with disabilities who cannot use fixed route bus and train service. This service is usually called "paratransit." The Van Tran service operates up to five nine-passenger vans and gives priority to ADA-certified disabled passengers within a ¾-mile zone around all MACS fixed routes, although they will travel beyond the ¾-mile buffer on occasion.

The vanpool system was updated in 2014 with a new approach to make it a successful operation. Other notable improvements include better bus stop facilities (bus stop signs and shelters) and a bus tracking system for the public. The FNSB intends to build eight more shelters in 2020. The Borough also conducts active public outreach and education to encourage the use of mass transit. Table 7.7.3-16 below displays the number of MACS riders from 2008-2018.

Table 7.7.3-16. Transit program ridership levels from 2008-2019

Table 7.7-6 Annual MACS Transit Ridership 2008 – 2019	
Year	MACS Number of Riders

2008	294,142
2009	357,964
2010	383,773
2011	391,799
2012	428,166
2013	475,875
2014	550,226
2015	533,045
2016	534,705
2017	528,000
2018	523,000*

*The anticipated ridership for 2018/2019 will not be final until July 1, 2019. The slight decrease in ridership compared to 2017/2018 is due to a reduction in some service time on 2 of the Borough's mass transit bus routes.

7.7.3.11 DOT Anti-Idling and Diesel Emission Reductions

Anti-idling (idle reduction) technologies provide a means to reduce air pollution from transportation sources. Emissions from vehicles are directly related to the amount of fuel used and the rate at which it is used. By reducing the need to have the vehicle engine on, emission reductions are achieved. Hence, the transportation control strategy, which has since been discontinued, was implemented as one of Moderate SIP voluntary control measures in the Fairbanks nonattainment area.

In July 2011, the Alaska Department of Transportation & Public Facilities (DOT&PF) began to focus on anti-idling and its potential benefits statewide. According to the DOT&PF, reducing idling saves money, conserves fuel, reduces engine wear and maintenance, extends the life of heavy equipment, and helps to preserve the environment. Consequently, the Alaska Department of Environmental Conservation coordinated with DOT&PF to develop a Fairbanks specific CMAQ-funded pilot program aimed at reducing heavy diesel emissions in the nonattainment area. This program was implemented by DEC Air Quality staff in Fairbanks.

Table 7.7.3-17 below displays the number of participating fleets and the number of vehicles equipped with idle reduction through 2017

Table 7.7.3-17. Expansion of Diesel Anti-idling Program

Number of participating fleets	3
Number of vehicles equipped with idle reduction technology	39

7.7.3.12 DEC Diesel Emission Reduction Efforts

Diesel emission reduction efforts were one of the voluntary transportation control strategies identified in the Moderate SIP. When the efforts started in 2009, DEC, in conjunction with DOT&PF, used the American Recovery and Reinvestment Act of 2009 (ARRA) and Diesel

Emission Reduction Act of 2005 (DERA) funding to upgrade the engine of three 1985 Autocar KM64 trucks to meet the 2010 clean diesel requirements. Also in 2013, ADEC and DOT&PF retrofitted 23 diesel vehicles with anti-idling technology using DERA grant funding through 2016. DEC has since discontinued implementing the diesel emission reduction efforts under DERA, which are now being implement by the Alaska Energy Authority.

7.7.3.13 Federal Diesel Emission Reduction Programs

The diesel emission reduction programs are still being implemented by the federal government to address diesel emissions in nonattainment areas, including Fairbanks nonattainment area. EPA's National Clean Diesel Campaign works with manufacturers, fleet operators, air quality professionals, environmental and community organizations, and state and local officials to reduce diesel emissions. The National Clean Diesel Campaign offers Diesel Emission Reduction Act funding opportunities through the competitive National Clean Diesel Funding Assistance Program to fund retrofit projects using Smartway verified diesel emission reduction technologies and the non-competitive State Clean Diesel Grant Program that funds grant and loan projects for clean diesel projects. Smartway is a public-private initiative between EPA, large and small trucking companies, rail carriers, logistics companies, commercial manufacturers, retailers, and other federal and state agencies. Its purpose is to improve fuel efficiency and the environmental performance (reduction of both greenhouse gas emissions and air pollution) of the goods movement supply chains. Smartway evaluates emissions control technologies and determines the eligibility of individual technologies for funding under DERA grants. Federal emissions standards for exhaust and evaporative emissions exist for Light-Duty Vehicles, Trucks, and Motorcycles, Heavy-Duty Engines and Vehicles, and Non-road Engines and Vehicles. These emissions standards on manufacturers have incrementally reduced the amount of emissions permitted from each type of regulated engine, resulting in cleaner diesel engines.

7.7.3.14 Federal Motor Vehicle Control Program

The Federal Motor Vehicle Control Program (FMVCP) is the federal certification program that requires all new cars sold in 49 states (excluding California) to meet certain emission standards. The standards required by the ongoing FMVCP vary according to vehicle age. Newer vehicles are required to be considerably cleaner than older models. The more stringent emission standards required from newly manufactured vehicles have, over time, led to a drop in overall emissions from the vehicle fleet in Fairbanks nonattainment area, as older, dirtier vehicles are replaced with newer, cleaner vehicles.

While the Tier 2 emission standards, which were phased-in from 2004-2009, were meant to reduce emissions responsible for ozone and particulate from passenger cars, light trucks and larger passenger vehicles, the Tier 3 emission standards, which were phased-in 2017, are meant to further enhance the performance of motor vehicle emission control systems. The Tier 3 emission standards have continued to reduce both tailpipe and evaporative emissions from passenger cars, light-duty trucks, medium-duty passenger vehicles, and some heavy-duty vehicles.

7.7.3.15 Winter Season Open Burning Ban

DEC, through its existing regulations, 18 AAC 50.245 and 18 AAC 50.065, makes sure that smoke emissions from open burning do not increase in the Fairbanks nonattainment area even if the authority of the Borough to regulate open burning is removed through voter initiative. To facilitate the continued implementation of the Moderate SIP control measure, 18 AAC 50.065(f) prohibits open burning during the winter season between November 1 and March 31.[14] Although DEC contemplated a longer season (including October and April) for open burning restrictions in the nonattainment area, after receiving public comments in 2014 the then available data suggested that there is no significant air quality deterioration from normal open burning during these months. DEC also revised the definition of open burning in 2014 to address the concerns raised by the public regarding small winter fires for recreational warming and ceremonial purposes.

7.7.3.16 Reasonably Achievable Control Technology

The CAA section 172 (c) requirements for nonattainment areas apply to the $PM_{2.5}$ nonattainment area. Under this attainment plan, the requirements of CAA Part D, New Source Review (NSR) apply for major stationary sources. Section 302 of the CAA (42 U.S. C. 7602) defines a major stationary source as any stationary facility or source of air pollutants that directly emits, or has the potential to emit, 100 tons per year of any pollutant. Permits for construction and operation of new or modified major stationary sources within the nonattainment area must be approved through the NSR program. Within the FNSB, ADEC is responsible for issuing construction and Title V operating permits. DEC has incorporated the requirements for Prevention of Significant Deterioration (PSD) and nonattainment New Source Review in 18 AAC 50, Article 3. DEC actively implements its permit programs. The Air Quality Division issues and amends permits, conducts inspections, reviews reports from industry, provides compliance assistance, and takes enforcement actions when needed.

Under the Moderate SIP, each stationary source in the Fairbanks nonattainment area was the subject of a Reasonably Achievable Control Technology (RACT) analysis. The emission units for which RACT determinations were made include boilers, process heaters, and turbines. The $PM_{2.5}$ RACT is a fabric filter system for boilers. Additional $PM_{2.5}$ controls are considered unreasonable for process heaters and turbines. RACT for the SO_2 emissions is the use of low sulfur fuel for all the fuel combustion sources. RACT controls were not recommended for NO_X because control of NO_X is not an efficient method for reducing ambient $PM_{2.5}$ in Fairbanks.

All the emission units that were reviewed are already implementing the emission control techniques identified as RACT. All the coal-fired units are already equipped with fabric filters, and Alaskan coal has a very low sulfur content.

[14] 18 AAC 50.065

Best Available Control Measures Analysis for Fairbanks $PM_{2.5}$ Nonattainment Area

November 19, 2019

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1. Introduction

In November 2009, Fairbanks North Star Borough was designated as a Moderate nonattainment area for the 2006 24-hour Fine Particulate ($PM_{2.5}$) National Ambient Air Quality Standard (NAAQS).[1] On April 28, 2017, EPA officially re-classified the Fairbanks from "Moderate" to "Serious" nonattainment for the 24-Hour $PM_{2.5}$ standard.[2] The design value for the 2013-2015 period is 124 $\mu g/m^3$(microgram per cubic meter). The difference between this value and the ambient standard is 89 $\mu g/m^3$, which means that 98th percentile concentrations (the form of the standard) need to be reduced by 72% to demonstrate attainment.

The purpose of this document is to describe the process of identification and selection of Best Available Control Measures (BACM) for the $PM_{2.5}$ Attainment Plan for the Fairbanks North Star Borough (FNSB, or Fairbanks) in Alaska.

Presented below is a review of the regulatory requirements that need to be addressed in the review, analysis and selection of BACM. Also presented is a summary of revisions made to strengthen both FNSB and ADEC $PM_{2.5}$ regulatory controls, independent of the BACM selection process. This summary is relevant as it documents revisions made since the adoption of the Moderate Fairbanks $PM_{2.5}$ SIP which was approved by EPA on September 8, 2017.[3] Those revisions form the baseline set of controls against which control measures adopted in other communities and agencies are examined for BACM selection. A brief outline of the remainder of the report is also presented.

Requirements for BACM Analysis

The process for selecting BACM is defined in a series of steps detailed in the Final $PM_{2.5}$ Rule.[4] Those steps clarify and update PM_{10} control measure selection guidance presented in the Addendum to the General Preamble[5] for the selection of $PM_{2.5}$ controls for both Reasonably Available Control Measures (RACM), required for Moderate nonattainment areas and BACM for Serious nonattainment areas. Presented below is a summary of the BACM selection guidance presented in the Final $PM_{2.5}$ Rule.

- **Step 1: Develop a Comprehensive Inventory of Sources and Source Categories of Directly Emitted $PM_{2.5}$ and $PM_{2.5}$ Precursors** – The inventory identifies the contribution of each source category to directly emitted $PM_{2.5}$ and precursor emissions. This information is needed to understand the relative contribution and significance of

[1] https://www.gpo.gov/fdsys/pkg/FR-2009-11-13/pdf/E9-25711.pdf
[2] https://www.federalregister.gov/documents/2017/05/10/2017-09391/determinations-of-attainment-by-the-attainment-date-determinations-of-failure-to-attain-by-the
[3] https://www.federalregister.gov/documents/2017/09/08/2017-18768/air-plan-approval-ak-fairbanks-north-star-borough-2006-pm25
[4] https://www.gpo.gov/fdsys/pkg/FR-2016-08-24/pdf/2016-18768.pdf
[5] https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/19940816_59fr_41998-42017_addendum_general_preamble.pdf

each source to the overall burden on the nonattainment area. EPA requires the identification of both anthropogenic (man-made) and non-anthropogenic (natural) emissions. It also requires the analysis to start with the base year emissions inventory submitted with the Moderate area attainment plan and to update it as necessary to reflect growth, construction, shutdowns, roadway improvements and other relevant changes that affect activity within the nonattainment area. EPA also requires the Step 1 inventory to be consistent with the emissions inventory requirements for Serious area plans.

- **Step 2: Identify Potential Control Measures** – Consistent with earlier guidance, the $PM_{2.5}$ Final Rule requires states to identify controls for each of the primary and secondary emission sources developed to represent activity within the subject nonattainment area. The starting point for assembling a list of controls is the RACM analysis prepared for the Moderate SIP. All controls considered, but not adopted must be identified. States are required to examine a wide range of information sources on existing and potential control measures. Measures and technologies considered and implemented in attainment plans are a significant source of information. Other information sources include summaries of control measures assembled by regional planning organizations and local air quality consortiums. EPA also maintains online links to a variety of control programs. States are required to identify both existing and potential new measures for the source categories identified in the base emissions inventory. The goal is to identify a list of control measures that are more stringent than those adopted in the Moderate SIP.

- **Step 3: Determine Whether an Available Control Measure or Technology is Technologically Feasible** – This requires the consideration of many factors including impacts on the environment (e.g., air, water, noise, etc.) and energy (e.g., consumption, availability, etc.). Measures targeting area and mobile sources need to consider infrastructure, population size, workforce type and habits, etc. In addition the critical source parameters needed to assess the impacts of the technology need to be identified (e.g., fuel specifications, travel activity, EPA certification, etc.). A key consideration is whether the identified measure provides an emissions benefit beyond those provided by existing federal, state and local controls (i.e., is it more stringent?). Another consideration is the availability of information to contrast and quantify the emission impacts of an identified measure relative to existing control programs (i.e., again, is it more stringent).

- **Step 4: Determine Whether an Available Control Technology or Measure is Economically Feasible** – This step requires an explicit examination of the costs and emission benefits of the measure leading to an assessment of the $/ton of pollutant reduced. In contrast to the criteria employed in the RACM determination process, economic feasibility "is a less significant factor." States "may not eliminate a particular control measure as potential BACM if similar sources have successfully implemented such a measure." States are also required to consider technologically feasible measures that have not been implemented by similar sources, but can reduce emissions at a cost that is not prohibitive. The Final $PM_{2.5}$ Rule does not establish a specific $/ton threshold for economic feasibility. More expensive control measures must be adopted unless it can be demonstrated that costs and cost effectiveness are prohibitive relative to existing controls.

- **Step 5: Determine the Earliest Date by Which a Control Measure or Technology can be Implemented in Whole or in Part** – The CAA requires Serious area attainment plans to provide for the implementation of BACM no later than 4 years after reclassification of the area to Serious or prior to the statutory attainment date for the area. If a state determines that technologically and economically feasible measures can be implemented in whole or in part during this period they must be adopted and implemented as expeditiously as possible. Since Fairbanks was classified nonattainment for $PM_{2.5}$ in December, 2009 the statutory attainment date is December, 2019.

Revisions to Strengthen $PM_{2.5}$ Regulatory Controls

Recognizing the need to make continued progress towards attainment both the Borough and the state continued to evaluate and adopt regulatory controls after the submission of the Moderate area SIP. Since these controls form the baseline against which BACM technical and economic feasibility is to be assessed, a summary of the measures adopted is presented below.

Borough Ordinance Revisions

The $PM_{2.5}$ Air Quality Control Program is codified in Chapter 21.28. Numerous changes to the program were debated within the Assembly leading to the adoption of ten separate Ordinances amending the program since the submission of the Moderate Area Plan to EPA December 31, 2014 and January 29, 2015. Collectively, those changes significantly increased the coverage and authority of the program to control emissions within the nonattainment area. Passage of Proposition 4, the Home Heating Reclamation Act, on October 5, 2018, however, required the Borough to remove all of the ordinances implementing home heating restrictions, calling air quality alerts and enforcing them. In the absence of a local control program, the Clean Air Act requires states to take responsibility for implementing air quality control programs that move the community towards attainment of the NAAQS.

Alaska Administrate Code Revisions

Amendments were adopted in 2016 and 2017 to reflect locally-adopted control measures.

With an effective date of November 26, 2016, the SIP was adopted by reference. In addition, the following sections of Chapter 50, the Air Quality Code were amended:

- Section 50.025: Visibility and other special protection areas to establish three "air quality control zones" within the Fairbanks $PM_{2.5}$ Nonattainment Area: Goldstream, Fairbanks, and North Pole;
- Section 50.030: State air quality plan to adopt revisions to the State Air Quality Control Plan in Volume II Section III.D.5: Fairbanks North Star Borough $PM_{2.5}$ Control Plan;
- Section 50.075: Wood-fired heating device visible emission standards to lower visible emission standards for solid fuel-fired heating devices during air quality advisories and to

allow the Department discretion to prohibit operation of solid fuel-fire heating devices during air quality episodes;
- Section 50.076: Solid fuel-fired heating device fuel requirements to add the list of materials that cannot be burned in a solid fuel-fired heating device;
- Section 50.077: Standards for wood-fired heating devices to prohibit the reinstallation of wood-fired hydronic heaters and wood stoves that do not meet emission standards within a nonattainment area.

With an effective date of January 2, 2018, the following Sections of Chapter 50 of the Air Quality Code were amended:

- Section 50.030: State air quality plan to adopt revisions to the Control Plan and add language addressing nonattainment area permit requirements;
- Section 50.075: Wood-fired heating device visible emission standards to add new language on visible emissions standards and to remove language that is no longer applicable;
- Section 50.077: Standards for wood-fired heating devices to address requirements for wood-fired heating devices, heating device test methods and address heating devices located in the FNSB nonattainment area;
- Section 50.079: (New) to address requirements for coal-fired heating devices;
- Section 50.990: to add definitions.

The following amendments to Chapter 50 of the Air Quality Code are included as part of the Serious SIP development and will become effective upon the effective date of the regulations and when implemented:

- Add a new subsection 18 AAC 50.075(e)(3) that requires that curtailment declarations must state that operators of solid fuel fired devices shall withhold fuel and ensure that combustion has ceased within three hours of the declaration.
- Add a new subsection 18 AAC 50.075(f)(2) that visible emissions may not be observed crossing property lines.
- Amend 18 AAC 50.076(g), that before October 1, 2021 the requirements for selling wet wood apply, and after October 1, 2021, there is still a requirement to register and meet the requirements of selling wet wood but only for those who meet the requirements in (j)(1).
- Add a new subsection, 18 AAC 50.076(j), that identifies that the only wet wood that can be sold (after October 1, 2021) is round logs eight feet long in length, and only when the seller has confirmed the ability of the buyer to properly dry the wood for the next season.
- Add a new subsection, 18 AAC 50.076(k), that on or after October 1, 2021, a commercial wood seller required to be registered may only sell dry wood that has been
    - seasoned, split and stored covered for at least 9 months unless otherwise confirmed;
    - mechanically dried where the drying process has been inspected and approved by the department to ensure consistency and reliability; or
    - harvested from an inspected fire killed sources that has been split, stacked, stored covered and confirmed dry prior to freezing.

  - Subsection (k) also identifies all the requirements for marketing, record keeping, and other requirements and responsibilities of the commercial wood seller.
- Add a new subsection, 18 AAC 50.076(l), that states that all non-commercial wood sellers may not sell wet wood in the non-attainment area.
- The Department repealed and replaced Section 50.077 and reorganized and reordered the section to be consistent with state regulation drafting requirements and added several new sections.
  - Section 50.077(a), prohibits installation of wood-fired heaters, except as provided in (b) – (d); outdoor cord wood hydronic heaters are not allowed.
  - Section 50.077(b), allows pellet fueled fired hydronic heaters that are under 350,000 Btu per hour, provided they have a valid EPA certification, and meet 0.10 lbs/mmBTU, and is approved by the department.
  - Section 50.077(c), allows wood stoves and pellet stoves, provided they have a valid EPA certification, meet a 2.0 g/hr PM emission rate, approved by the department, and after September 1, 2020 also meet either the requirement of no rolling 60 minute period will exceed 4.0 g PM/hr if using a TEOM or no valid test run 1 – hour filter data measurement of 6.0 g PM/hr from the certifying test.
  - Section 50.077(d), allows wood fired devices with a capacity of 350,000 Btu per hour, provided they have a valid EPA certification, and meet a 2.0 g/hr PM emission rate, approved by the department
  - Section 50.077(e), the department will publish a list of devices that meet the criteria of sections (b) – (d).
  - Section 50.077(f), if a buyer or operator confirms in writing that a device that doesn't meet the requirements of 50.077, it may be sold if installed outside the nonattainment area.
  - Section 50.077(g), allows a temporary waiver to the requirements of (a), (l) – (n) but the department must consider financial hardship information, technical feasibility information, and potential impacts to locations with populations sensitive to $PM_{2.5}$ exposure.
  - Section 50.077(h) requires wood-fired heating devices to be registered with DEC
    - Upon sale or conveyance of a device,
    - Prior to closing, if the device is being sold, leased, or conveyed as part of an existing building or other property
    - when applying for a waiver
    - to participate in the Burn Right Program
    - to participate in any wood-stove change-out or conversion program
    - prior to closeout of any compliance or enforcement action.
  - Section 50.077(i), owner or operator of a wood fired heating device shall ensure the device or any retrofit control device is properly sized and professionally installed. The installer shall provide confirmation to the department. And installers must meet certification criteria the department has adopted from the National Fireplace Institute and the Masonry Heater Association of North America. For retrofit control devices, the installer must meet either the above listed criteria or be a representative trained by the manufacturer. Section 50.077(j), a person may not install:

        - A pellet fueled wood fired hydronic heater within 330 feet of the closest property line or within 660 feet from a school, clinic, hospital or senior housing unit.
        - A wood fired heating device as the primary or only heat source in:
            - New construction except a new dry cabin located on a two acre parcel.
            - A structure used as a rental unit unless it has been used as a rental prior to the new regulations being effective and qualifies for a NOASH waiver.
    - Section 50.077(k), requires vendors of wood fired heating devices may not advertise devices prohibited for sale in this section within the nonattainment area and shall provide a buyer with curtailment information and proper operating instructions at the time of sale.
    - Section 50.077(l), requires owners of devices that do not have an EPA certification, and non-pellet fueled outdoor hydronic heaters to render the device permanently inoperable before December 31, 2024; or before its is sold as part of an existing structure, whichever is earlier.
    - Section 50.077(m), that any device not allowed to be reinstalled shall be rendered permanently inoperable when it is removed.
    - Section 50.077(n), if triggered, this contingency measure requires EPA certified devices that are 25 years or older at the time of the EPA finding must be removed by December 31, 2024. And, as EPA certified devices become 25 years old, they must be removed either when sold or conveyed as part of an existing building or once they reach 25 years from the date of manufacture, whichever is earlier.
- Add a new Section 50.079(f): Existing coal-fired heating devices to be:
    - Removed or replaced by December 31, 2024
    - Removed or replaced before being sold, leased or conveyed as part of an existing building
    - Removed devices shall be destroyed or rendered inoperable
- Add in the Episode Chapter[6] revised Advisory and Alert thresholds:
    - Advisory - 15µg/m^3
    - Stage 1 – 20 µg/m^3
    - Stage 2 – 30 µg/m^3
- Add in the Episode Chapter revised NOASH and Exemption requirements:
    - Length of waivers based on age and emission rate of the device
    - Annual renewals on oldest and highest emission rated devices
    - 3rd party inspection of device to verify proper installation required
    - 3rd party inspection of maintenance (chimney sweep) required
    - Device registration required
    - Documentation of dry wood required
- Add a new subsection 50.078(b): After September 1, 2022, only fuel oil containing no more than 1,000 parts per million sulfur may be sold or purchased for use in fuel oil-fired equipment, including space heating devices.

[6] Vol. II: III.D.7.12, Fairbanks Emergency Episode Plan, hereafter referred to as the Episode Chapter

- Add a new subsection 50.078(c): One time submission of information requirement for small area sources: charbroilers, incinerators and waste oil burners
- Add a new subsection 50.078(d): Requires that coffee roasters within the area install a pollution control device appropriate to the unit approved by the department on any unit that emit 24 pounds or more of particulate matter in a 12-month period, unless the facility provided information demonstrating control technology is technically or economically infeasible. The requirement for installation of control equipment on coffee roasters will be 1 year from the effective date of regulation

In addition to the code revisions noted above, the Serious designation triggered the implementation of contingency measures contained in the Moderate $PM_{2.5}$ SIP. Alaska's regulations contain two contingency measures for the Fairbanks $PM_{2.5}$ nonattainment area. The first addressed property transactions and went into effect immediately. It requires removal or replacement of older, more polluting, solid fuel-fired devices when a property is sold, leased, or conveyed which will accelerate turnover and result in fewer of these devices operating in the area and reduce wood smoke emissions. Solid fuel-fired devices that appear on any of DEC's lists of EPA-certified and Phase 2 "White Tag" devices do not need to be removed or replaced. The second requires commercial wood sellers to register with the state and disclose the moisture content of wood they sell; it went into effect after a 60-day public notice period. This information aids consumers to make educated decisions about whether wood needs to be seasoned to reduce its moisture content to less than 20%, or if the wood is dry and can be burned right away.

Outline for Remainder of the Section

The remainder of this document is organized to present the findings of analyses addressing each of the 5 BACM steps outlined above. Section 2 presents a summary of the calculations prepared to quantify the baseline emission inventory (Step 1). A summary of the process followed to identify potential control measures is presented in Section 3 (Step 2). Section 4 presents the results of the technological feasibility analysis prepared for each of the measures identified in Section 3 (Step 3). Section 5 presents the results of the economic feasibility analysis for each measure determined in Step 3 to be technologically feasible (Step 4). Section 6 presents information on the earliest date at which measures determined to be technologically feasible (and/or adopted in a new state regulation) in Step 3 and economically feasible in Step 4 can be implemented (Step 5). Section 7 presents a summary of the selected BACM measures. Appendix A contains a reference to the state's analysis of the costs of transitioning to lower sulfur heating oil.

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2. Step 1 – Develop a Comprehensive Inventory of Sources and Source Categories of Directly Emitted $PM_{2.5}$ and $PM_{2.5}$ Precursors

The first element in the multi-step BACM process consists of the development of an emission inventory (EI) of sources of directly-emitted $PM_{2.5}$ and $PM_{2.5}$ precursors within the nonattainment area. This section describes that process. It includes a list of all source categories reflected in the inventory and a summary of the sources and activities in the nonattainment area. It also includes a summary of emissions by source category of both directly emitted $PM_{2.5}$ and its precursors.

Source Categories Inventoried

Overview - The inventory supporting the BACM analysis was developed in a manner consistent with the EI requirements for Serious area plans specified in EPA's $PM_{2.5}$ Implementation Rule[7] (or PM Rule). This included representation of source activity and emissions on a seasonal, rather than annual basis as provided for under the PM Rule. As discussed in the separate Emission Inventory document, use of seasonal estimates is appropriate for the 24-hour $PM_{2.5}$ standard in Fairbanks since violations of the standard are confined to winter months (October through March) and source activity that triggers these violations peaks during that time.

The inventory was developed using the 2008 base year emission inventory for the Fairbanks $PM_{2.5}$ nonattainment area from the approved Moderate SIP as its starting point and then updated based on additional source and activity data collected since preparation of that inventory. The inventory was projected forward to calendar year 2019 and reflects growth, and controls in place at the end of 2018.

This inventory covers activity and emissions across the following source types:

1. *Stationary Point Sources* – Industrial facility emissions for major stationary sources based on the major source reporting threshold of 70 tons/year as required for Serious plan inventories under the PM Rule;

2. *Stationary Nonpoint (or Area) Sources* – Includes all remaining stationary sources, including both industrial facilities below the major source reporting threshold above as well as "traditionally" defined area sources such as residential and commercial space heating and other disperse stationary emission sources;

3. *On-Road Mobile Sources* – Represents activity and emissions from on-road motor vehicles which includes gasoline and diesel-powered passenger cars, light-duty trucks/vans, buses and heavy-duty trucks; and

[7] Federal Register, Vol. 81, No. 164, August 24, 2016 (FR 81 58010).

4. *Non-Road Mobile Sources* – Emissions from all remaining mobile sources than are not on-road certified vehicles. This includes non-road vehicles/equipment such as construction/mining equipment, off-highway vehicles, snowmobiles and other recreational vehicles, aircraft and airfield equipment and locomotives.

Figure 1 shows the boundaries of the Fairbanks $PM_{2.5}$ nonattainment area (shaded region) overlaid on the roadway system in the area. The nonattainment area covers 271 square miles. Figure 1 also shows the names and locations of the six major point sources located within the nonattainment area (using blue dots).

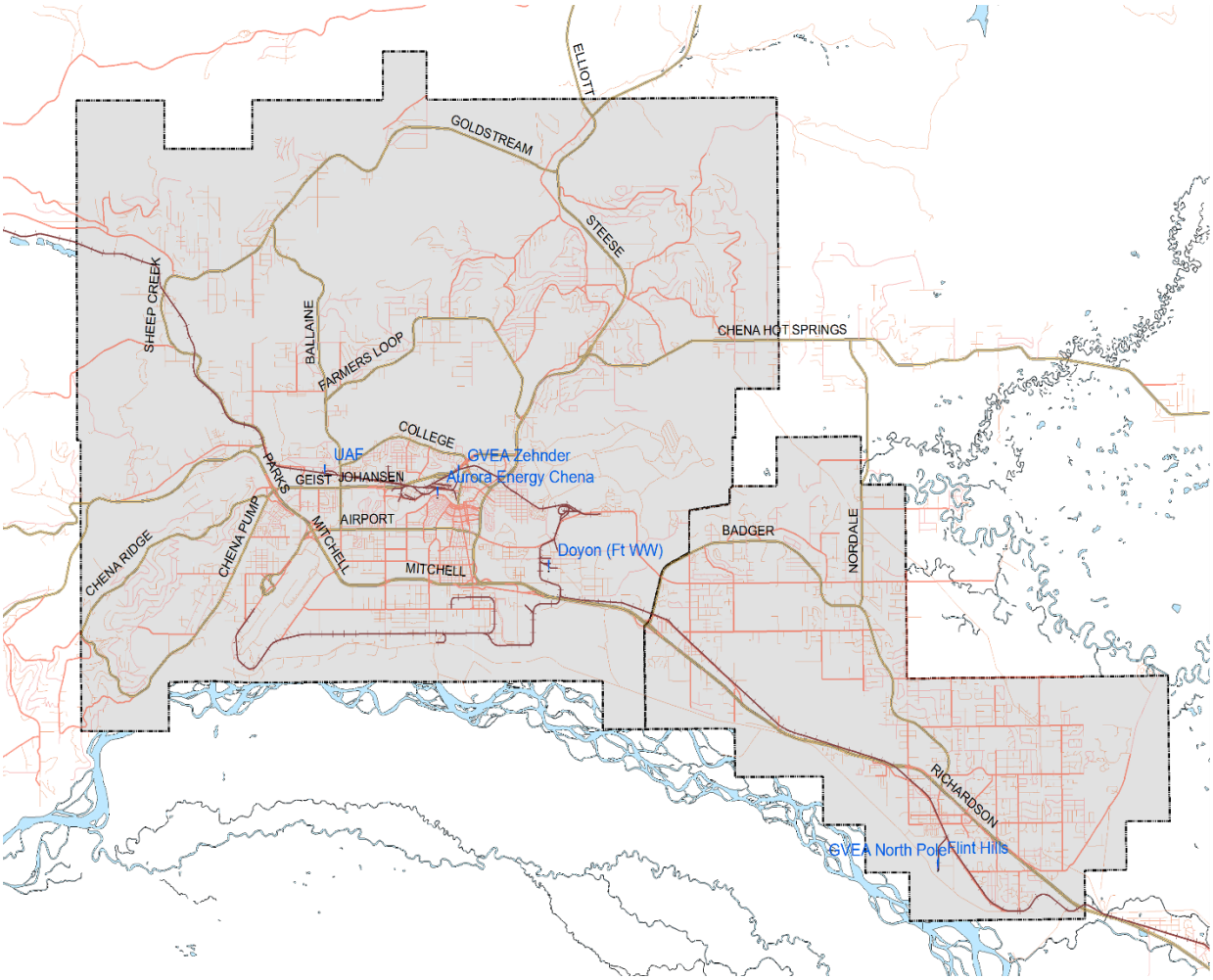

Figure 1. Fairbanks $PM_{2.5}$ Nonattainment Area

Sources Included and Pollutants Covered – The inventory included a review of all anthropogenic and biogenic emission sources within the nonattainment area. As described in greater detail in the Emission Inventory document, it was determined that biogenic emissions were negligible during the winter season represented in the inventory. In addition, fugitive dust sources of $PM_{2.5}$ were also estimated to be negligible under the snow/ice bound conditions reflected in the winter seasonal inventory.

Pollutants represented in the inventory consisted of both direct $PM_{2.5}$ as well as emissions of potential precursor pollutants: sulfur dioxide (SO_2), oxides of nitrogen (NOx), volatile organic compounds (VOC), and ammonia (NH_3).

Summary of Inventory Data Sources and Methods – Table 1 briefly summarizes the data sources and methods used to develop the emissions inventory by source type. It also highlights those elements based on locally-collected data. As shown by the shaded regions in Table 1, the majority of wintertime activity and emission factor data supporting the inventory was developed based on local data and test measurements.

Table 1. Summary of Data/Methods Used in Serious SIP Inventory

Source Type/Category	Source Activity	Emission Factors
Point Sources	Facility and stack-level fuel use and process throughput	Continuous emissions monitoring or facility/fuel-specific factors
Area (Nonpoint) Sources, Space Heating	Detailed wintertime Fairbanks non-attainment area residential heating device activity measurements and surveys	- Test measurements of common Fairbanks wood and oil heating devices using local fuels - AP-42 factors for local devices or fuels not tested (natural gas, coal)
Area Sources, All Others	- Seasonal, source category-specific activity from a combination of State/Borough sources - National Emission Inventory (NEI)-based activity for commercial cooking	AP-42 emission factors
On-Road Mobile Sources	Local estimates of seasonal vehicle miles traveled	- MOVES2014b emission factors based on local fleet/fuel characteristics - Augmented with Fairbanks wintertime vehicle warmup and plug-in emission testing data
Non-Road Mobile Sources	- Local activity estimates for key categories such as snowmobiles, aircraft and rail - MOVES2014b model-based activity for Fairbanks for other categories	- MOVES2014b model factors for non-road equipment - AEDT model factors for aircraft - EPA factors for locomotives

For all inventory sectors, emissions were calculated using a "bottom-up" approach that relied heavily on an exhaustive set of locally measured data used to support the emission estimates. For source types for which local data were not available, estimates relied on EPA-developed NEI

county-level activity data and emission factors from EPA's *Compilation of Air Pollutant Emission Factors*,[8] AP-42 database.

Within the inventory, activity and emissions were represented at the individual Source Classification Code (SCC) level, with the exception of the major point sources. Major point source emissions were compiled by SCC, facility and emission unit.

Updating Moderate SIP Estimates – The Moderate SIP contained a 2008 base year inventory. This inventory was updated to the 2013 baseline year of the Serious Plan based on a combination of activity projections (for example population/housing growth) from 2008 to 2013 and new or revised activity estimates and emission factors/models which are summarized below for the key elements. These values were projected to 2019 and reflect changes due to growth, and controls in place at the end of 2018.

- *Point Sources* – 2008 activity and emissions data were projected to 2013 and 2019 based on annual fuel use/process throughput by individual facility and emission unit. Fuel-based ammonia emissions for point sources were also included in the 2019 inventory.

- *Space Heating Area Sources* – Additional home heating survey data collected in winters 2012 through 2015 were used to augment the estimates of residential space heating device/fuel mix and usage in the Moderate SIP based on the singular 2011 Home Heating survey. This broader sample of survey data was combined to more robustly reflect residential space heating activity within the nonattainment area for calendar year 2013 (which is centered in the combined 2011-2015 home heating survey period) and projected forward to 2019. Additional survey data were also collected from commercial businesses in the nonattainment area to estimate the extent of space heating from solid fuel burning devices (wood or coal) in commercial buildings. (The Moderate SIP assumed all commercial space heating used only liquid (heating oil) or gaseous (natural gas) fuels).

- *Mobile Sources* – For both on-road and non-road vehicles, EPA's latest vehicle emissions model, MOVES2014b was used to replace emission estimates from the Moderate SIP based on its predecessor, MOVES2010a.[9] On-road vehicle activity (VMT and speeds) was based on 2019 travel demand model outputs from the Fairbanks Metropolitan Area Transportation System (FMATS[10]) 2040 Metropolitan Transportation Plan (MTP). (The Moderate SIP used travel model estimates for 2008 from a prior transportation plan.) For non-road vehicles/equipment MOVES2014b was used to calculate 2019 calendar year emissions. The Federal Aviation Administration's AEDT model was used to estimate

[8] "Compilation of Air Pollutant Emission Factors," Fifth Edition and Supplements, AP-42, U.S. EPA, Research Triangle Park, NC. January 1995.
[9] MOVES2014b models both on-road and non-road vehicles/equipment. MOVES2010a only modeled emissions from on-road vehicles; a separate model NONROAD2008 was used in the Moderate SIP to address non-road vehicle emissions.
[10] The FMATS metropolitan planning organization transitioned in 2019 to the new Fairbanks Areas Surface Transportation (FAST) Planning organization.

aircraft/airfield emissions in 2019 based on activity data collected for that year. (The Moderate SIP used the predecessor model to AEDT, EDMS, based on 2008 activity).

Summary of Emissions

Emissions for the 2013 baseline inventory within the Fairbanks $PM_{2.5}$ nonattainment area were updated from the 2008 Moderate SIP base year inventory as summarized in the preceding section. They were tabulated by key source sector and updated to reflect the effects of growth through 2019 and controls in place at the end of 2018. Table 2 presents the resulting Control emission inventory estimates, expressed as average day emissions within the winter season for 2019. Emissions of direct $PM_{2.5}$ are highlighted in the first column. Precursor pollutant emissions are also shown. As seen in Table 2, the largest share of direct $PM_{2.5}$ comes from space heating, with wood-burning being the dominant fuel type. For NOx and SO_2, point sources are the dominant contributor. (The majority of VOC and NH_3 precursors emissions also come from space heating).

Table 2. 2019 Control Emissions Inventory (tons/day) by Source Sector

Source Sector	Nonattainment Area Winter Season Emissions (tons/day)				
	$PM_{2.5}$	**NOx**	**SO_2**	**VOC**	**NH_3**
Point	0.83	10.63	7.13	0.09	0.020
Area, Space Heating, All	2.11	2.44	3.87	8.62	0.132
Area, Space Heat, Wood	1.95	0.40	0.14	8.40	0.086
Area, Space Heat, Oil	0.07	1.83	3.61	0.10	0.004
Area, Space Heat, Coal	0.08	0.05	0.09	0.11	0.014
Area, Space Heat, Other	0.01	0.17	0.02	0.01	0.029
Area, Other	0.20	0.25	0.02	2.35	0.049
On-Road Mobile	0.14	1.83	0.01	2.86	0.038
Non-Road Mobile	0.24	1.21	10.62	0.41	0.000
TOTALS	**3.53**	**16.36**	**21.64**	**14.33**	**0.238**

To provide a clearer understanding of the significance of each source sector, Table 3 provides a breakdown of the percentage contributions of each sector (or subcategory) to total emissions for each pollutant. As shown in Table 3 over 59% of direct $PM_{2.5}$ comes from space heating. Point sources contribute just under 24% of direct $PM_{2.5}$, with other area sources and mobile sources accounting for the remaining 17%. For NOx, point sources are the major contributor, accounting for 65% of total emissions. Space heating is the second largest NOx source, representing 15%. SO_2 emissions come primarily from non-road mobile sources (49%), with point sources contributing the next largest share (33%).

Since the portion of emission sources encompassing all categories except point sources are subject to BACM (point sources are addressed under BACT), these tabulations show that space heating is the dominant, but not singular source of emissions under BACM.

Table 3. 2019 Control Emissions Inventory
Contributions by Source Sector (% of total pollutant emissions)

Source Sector	Nonattainment Area Winter Season Emissions (tons/day)				
	$PM_{2.5}$	**NOx**	**SO_2**	**VOC**	**NH_3**
Point	23.6%	65.0%	32.9%	0.6%	8.3%
Area, Space Heating, All	59.6%	14.9%	17.9%	60.2%	55.5%
Area, Space Heat, Wood	55.2%	2.4%	0.7%	58.6%	36.1%
Area, Space Heat, Oil	1.9%	11.2%	16.7%	0.7%	1.5%
Area, Space Heat, Coal	2.2%	0.3%	0.4%	0.8%	5.8%
Area, Space Heat, Other	0.4%	1.0%	0.1%	0.1%	12.1%
Area, Other	5.8%	1.5%	0.1%	16.4%	20.4%
On-Road Mobile	4.1%	11.2%	0.0%	20.0%	15.8%
Non-Road Mobile	6.9%	7.4%	49.1%	2.9%	0.0%
TOTALS	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

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3. Step 2 – Identify Potential Control Measures

The second step in the BACM identification and evaluation process is to identify candidate control measures. In this step, a list of control measures potentially applicable to the mobile and area source $PM_{2.5}$ source categories is developed for consideration as BACM. States are required to examine a wide range of information sources on existing and potential control measures in the search for candidate BACM. The Final $PM_{2.5}$ Rule requires the list of potential controls to include "options not previously considered as RACM/RACT", control measures being implemented in other nonattainment areas, and measures considered by regional planning organizations and state and local air quality consortiums. The goal is to identify a list of control measures that are more stringent than those adopted in the Moderate Area SIP. Presented below is a summary of agencies and measures considered, and the measures selected for consideration as BACM. RACT-related sources and control technologies are addressed in the Moderate SIP.

RACM

As noted earlier, the starting point for assembling a list of controls is the RACM analysis prepared for the Moderate Area SIP. All controls that were considered, but not adopted, must be identified. Table 4 lists the measures the RACM analysis determined to be technologically infeasible (Table 5.7-6. Candidate Control Measures Considered for RACM) and economically infeasible (Table 5.7-7. Technologically Feasible Control Measures). Many of the measures determined to be technologically infeasible were rejected because of a referendum that was in place prohibiting the Borough from regulating home heating systems and fuels. The referendum has since lapsed; however, a replacement initiative was passed by local voters in the 2018 fall election. Several measures were rejected because they were determined to be not practically enforceable in the Borough. The Final $PM_{2.5}$ Rule eliminated this criterion as a basis for infeasibility. Two of the measures were determined to be economically infeasible. The first provided economic incentives to switch to lower sulfur fuel oil. The second addressed expansion of the District heating system. Both measures are considered here as candidate measures for BACM.

The RACM analysis noted that "Five of the technologically feasible and cost effective control measures have not already been implemented." They included:

- Hydronic heaters: voluntary curtailment on air quality advisory days
- Hydronic heaters: All new units must be certified to 2.5 gm/hr
- Wood stoves: All new units must be certified to 2.5 gm/hr
- Open burning: Reinstate open burning ban
- Burn barrels: Prohibit use of burn barrels (seasonal or year-round)

The RACM analysis stated that all "of these measures may be implemented within four years of designation, with a target implementation date of 1st Qtr 2016." While those measures were all implemented in early 2016, the Borough regulations were removed following voter approval of

the Home Heating Reclamation Act in 2018 and these programs are now being regulated solely by ADEC. All of these measures are addressed in the BACM analysis.

Table 4 lists source categories, the titles of control measure and the disposition/Measure # of each. The title of the control measure includes a sequence number identifying its place in the RACM analysis. The disposition/Measure # column lists each of the sequence numbers assigned to measures evaluated in the BACM analyses. Those starting with the letter R indicate that it is RACM measure. The measure sequence numbers not preceded by the letter R (e.g., Ban on green wood sales is listed as 36) indicate the candidate BACM measures identified in the review of regulations adopted by other jurisdictions that address the same source category. Some of the RACM measures deemed infeasible are addressed in multiple control strategies identified in the regulations of other jurisdictions and include multiple measure sequence numbers (e.g., Mandatory curtailment on Air Quality Advisory Days is addressed in Measures 19, 22 and 35). Measure "19. Use stove change outs to generate NSR offsets" is addressed as a candidate BACT measure in the BACT report. Each of the other measures listed in Table 4 is analyzed for technical feasibility in Step 3.

Table 4. Fairbanks RACM Controls Found to be Technologically Infeasible

Source Category	Control Measure	Measure #
Dry Wood	1. Regional kiln	R1
	2. Ban on green wood sales	36
Hydronic Heaters	3. Mandatory curtailment on Air Quality Advisory Days	19, 22, 35
	4. All units must be certified	R4
	5. Ban new installations	R5
	6. Remove at time of home sale	R6
	7. Ban use	R7
Wood Stoves	8. Mandatory curtailment on Air Quality Advisory days	19, 22, 35
	9. All units must be certified	R9
	10. Replace uncertified units at time of sale	R10
	11. Replace uncertified units at time of significant remodeling	R11
	12. Replace uncertified stoves in rental units	R12
	13. Require alternate heat source in rental units	24
	14. Require alternate heat source in new construction	8
	15. Ban new installations	R15
	16. Disincentives to sell used stoves	R16
	17. Ban use	R17
	18. Use stove change outs to generate NSR offsets	BACT Measure
Fireplace	19. Mandatory curtailment on Air Quality Advisory days	19, 22, 35
Transportation*	20. HOV lanes	R20

Table 4. Fairbanks RACM Controls Found to be Technologically Infeasible

Source Category	Control Measure	Measure #
	21. Traffic flow improvement program	R20
	22. Create non-motorized traffic zones	R20
	23. Employer-sponsored flexible work schedules	R20
	24. Retrofit diesel fleet (school buses, transit fleets)	R20
	25. On-road vehicle I/M program	R20
	26. Heavy-duty vehicle I/M program	R20
	27. State LEV program	R20
Fairbanks RACM Controls Found to be Economically Infeasible		
Residential Fuel Oil Combustion	28. Provide economic incentives to switch to low sulfur fuel	51
	29. Increase Coverage of District Heating Systems	R29

* All listed transportation measures are addressed as a single measure – R20.

Control Measures Implemented in Other Nonattainment Areas

A wide range of rules implementing SIP controls were examined to identify control measures for consideration as BACM. Table 5 lists the local jurisdictions and states whose regulations were examined to identify potential $PM_{2.5}$ control measures. It also lists the links to 33 separate websites containing rules and regulations adopted by these jurisdictions to control $PM_{2.5}$ emissions. Several states and local jurisdictions have multiple rules addressing $PM_{2.5}$ control. Most rules are extensive and contain separate sections addressing definitions, prohibitions, stage restrictions, exemptions, penalties, etc. Use of these links facilitated the comparative evaluation of control program requirements in the Fairbanks North Star Borough and State of Alaska to those of other jurisdictions to determine if those of other jurisdictions are potentially more stringent than corresponding Fairbanks' requirements - the screening qualification for consideration as BACM.

After reviewing the range of $PM_{2.5}$ control programs in place across the country, it became apparent that many had similar structures, and detailed requirements reflecting local decisions about how best to implement needed controls. Since the programs reviewed did not fit into a uniform template, evaluations of them had to be conducted in a careful manner to understand requirement nuances. Definitions differ, prohibitions and thresholds for implementation differ, exemptions frequently differ, etc. Thus, while it was tempting to contrast entire regulatory packages to determine which provided the largest reduction in emissions, quantification of reductions was found to be a complex exercise because of the numerous regulatory differences between these packages and that of Fairbanks. Several of the findings made during this initial approach were that:

1. Considerable effort would be required to develop separate spreadsheets for each regulatory package to quantify overall emission benefits in Fairbanks;

2. Individual components of regulatory packages that could provide benefits in Fairbanks could be missed if other components of the same packages offset these benefits when packages were considered in total (i.e., throwing the baby out with the bathwater);
3. Comparisons of individual regulatory elements is easier to analyze and present for review;
4. Comparisons of individual regulatory elements do not require spreadsheet analysis to determine which elements are more stringent;
5. Frequently, the data or estimates needed to contrast measures quantitatively do not exist: impacts on emissions due to differences in exemption details, approved device categories, installation requirements, curtailment requirements, enforcement policies, shifts in behavior, etc.

Collectively, the issues listed above led to a decision to contrast elements of regulatory packages with those of the Borough and the State of Alaska. The search for regulatory elements that appeared to be more stringent than those in Fairbanks and Alaska regulations first produced a list of jurisdictions implementing them and web links to the applicable regulations. This list is presented in Table 5.

Table 5. Programs Examined to Identify Candidate $PM_{2.5}$ Control Measures

Location/Information Sources
Arvada, CO – https://yosemite.epa.gov/r8/r8sips.nsf/e5e850cc767bc8b3872573a9004cad73/bd3b257587d4a7de87257e0c00703faf/$FILE/ATTBMOIH.pdf/(c)(1)%205%20CCR%201001-6,%20Reg%204.8.1.%20Arvada%20Ord%202451.pdf
Georgia, GA – https://epd.georgia.gov/air/sites/epd.georgia.gov.air/files/related_files/document/narrative_08.16.12%20atlanta.pdf
Alaska, AK – http://dec.alaska.gov/commish/regulations/pdfs/18-AAC-50.pdf
Aurora, CO – https://library.municode.com/co/aurora/codes/building_and_zoning?nodeId=BUZOCO_CH146ZO_ART12SURESPUSAC_DIV1GEUS_S146-1204BURE
Idaho, ID – https://www.deq.idaho.gov/media/930589-cache_valley_pm2_5_nonattainment_state_implementation_plan_1212.pdf – https://adminrules.idaho.gov/rules/2014/58/0101.pdf – http://www.deq.idaho.gov/media/930593-cache-valley-pm2-5-sip-appendices-1212.pdf
Colorado, CO – https://yosemite.epa.gov/R8/R8Sips.nsf/PrintSips/C5D17E5CB9461F8587257EED004BBD82?OpenDocument – https://www.colorado.gov/pacific/cdphe/aqcc-regs – https://www.colorado.gov/pacific/sites/default/files/5-CCR-1001-6_1.pdf
Delaware, DE – http://regulations.delaware.gov/AdminCode/title7/1000/1100/1113.shtml
Fairbanks North Star Borough, AK – http://www.codepublishing.com/AK/FairbanksNorthStarBorough/#!/FNSBC21/FNSBC2128.html#21.28

Table 5. Programs Examined to Identify Candidate $PM_{2.5}$ Control Measures

Location/Information Sources
Feather River AQMD, CA – https://www.arb.ca.gov/drdb/fr/cur.htm
Imperial County, CA – https://www.arb.ca.gov/drdb/imp/cur.htm
Kern County, CA – https://www.arb.ca.gov/drdb/ker/cur.htm
Klamath County, OR – http://www.co.klamath.or.us/EH/Air%20Quality%20&%20Burning/Klamath%20County%20Clean%20Air%20Ordinance.htm
Lincoln County, MT – http://lincolncountymt.us/images/departments/environmental_health/pdf/air_quality/AirOrdinanceRev_10MAY2017.pdf
Maine, ME – https://www.maine.gov/sos/cec/rules/06/096/096c150.doc
Maricopa County, AZ – http://www.maricopa.gov/DocumentCenter/View/5332 – http://www.maricopa.gov/DocumentCenter/View/5252 – http://www.maricopa.gov/DocumentCenter/View/5200
Missoula City-County, MT – https://www.missoulacounty.us/home/showdocument?id=8452
New York State, NY – https://govt.westlaw.com/nycrr/Browse/Home/NewYork/NewYorkCodesRulesandRegulations?guid=I591033205f9311e0b70f0000845b8d3e&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default) – http://www.dec.ny.gov/chemical/51986.html
Ada County, ID – http://www.sterlingcodifiers.com/codebook/index.php?book_id=447
Lane Regional APA, OR – http://www.lrapa.org/DocumentCenter/View/253 – https://www.lanecounty.org/UserFiles/Servers/Server_3585797/File/Government/County%20Departments/County%20Counsel/Lane%20Code/LC09.pdf
Pennsylvania, PA – https://www.pacode.com/secure/data/025/chapter123/s123.14.html
Utah, UT – https://rules.utah.gov/publicat/code/r307/r307-302.htm
Puget Sound CAA, WA – http://www.pscleanair.org/219/PSCAA-Regulations
Bay Area AQMD, CA – https://www.arb.ca.gov/DRDB/BA/CURHTML/R6-3.PDF
San Juaquin Valley APCD, CA – https://www.valleyair.org/rules/currntrules/r4901.pdf
South Coast AQMD, CA – https://www.arb.ca.gov/DRDB/SC/CURHTML/R445.PDF – https://www.arb.ca.gov/DRDB/SC/CURHTML/R444.PDF
Vermont, VT – http://dec.vermont.gov/sites/dec/files/aqc/laws-regs/documents/Statutes07-01-2014.pdf#zoom=100
Washington, WA

Table 5. Programs Examined to Identify Candidate $PM_{2.5}$ Control Measures

Location/Information Sources
– http://apps.leg.wa.gov/WAC/default.aspx?cite=173-400

The next step was to isolate the specific elements in these rules and regulatory packages that appeared to be more stringent than the corresponding elements in FNSB and Alaska regulations. These elements were assigned short descriptive titles and then organized into groups of common functionality. In other words, all of the specific elements that regulated device installation were grouped together under the group title of "Device Installation – General". Element groups were then organized in a sequence that followed the chronological events in device acquisition, use, and retirement, such as sale, installation, permitting, exemption granting, operation, curtailment during air quality advisories, and removal. Because the analysis of source categories contributing to $PM_{2.5}$ nonattainment in the Borough identified coal burning, heating oil combustion, and motor vehicle travel as being significant, elements of regulations implemented by other jurisdictions that addressed these sources were grouped together in separate categories. The list of these functionality groups and individual regulatory elements evaluated is presented in Table 6. Listed with each regulatory element are the jurisdictions implementing these elements.

Table 6. Control Measures Implemented in $PM_{2.5}$ Nonattainment Areas That Have Not Been Implemented in FNSB

Measure Description	Areas Implementing Measure
Sale of Devices - New	
1. Surcharge on Device Sales	Washington, WA
Sale of Devices – Used	
2. Prohibit advertising used devices that do not meet emission criteria for new device sales	Ada County ID Utah, UT Colorado, CO
Device Installation – General	
3. Require building or other permit	Missoula City-County MT Ada County ID Klamath County OR
4. Require confirmation of proper installation by requiring professional installation or on-site inspection	San Joaquin Valley APCD CA
5. Register/require industry certification of heating professionals	San Joaquin Valley APCD CA
6. Prohibit installation of flue dampers unless device was certified using a flue damper	Missoula City-County MT
7. Require devices meet stricter emission criteria in high pollution zones.	Missoula City-County MT
8. Prohibit installation of Solid Fuel Heating Device (SFHD) in new construction	South Coast AQMD CA San Joaquin Valley APCD CA Bay Area AQMD CA

Table 6. Control Measures Implemented in $PM_{2.5}$ Nonattainment Areas That Have Not Been Implemented in FNSB

Measure Description	Areas Implementing Measure
9. Limit the density of SFHD in new developments	San Joaquin Valley APCD CA East Kern AQMD CA
10. Install EPA-certified device whenever a fireplace or chimney is remodeled	Bay Area AQMD CA
Device Installation - Hydronic Heaters	
11. Prohibit use of rain caps on stacks	Maine, ME
12. Require minimum stack height relative to rooflines of nearby unserved buildings	Maine, ME New York, NY Utah, UT
13. Submit sale and installation information to Air Program	New York, NY
14. Require installation of thermal mass to improve efficiency and prevent frequent cycling in selected new units	U.S. Environmental Protection Agency
Device Removal	
15. Disclosure of devices on property sale	Lane Regional APA OR San Joaquin Valley APCD CA
16. Require notice and proof of destruction or surrender of removed, uncertified devices	Puget Sound CAA WA
17. Require Removal of Uncertified Solid Fuel Burning Devices Upon Sale of Property	Puget Sound CAA WA
Device Operation – Opacity	
18. No Visible Emissions during Curtailment Periods	Puget Sound CAA WA Maricopa County AZ
Device Operation – Permits	
19. Require registration of devices to qualify for exemption from curtailments	Missoula City-County MT San Joaquin Valley APCD CA
20. Require renewals with inspection requirements	San Joaquin Valley APCD CA
21. Optional device registration for curtailment exemptions	San Joaquin Valley APCD CA Maricopa County AZ
22. Require registration of all devices	Missoula City-County MT
23. Require exempt households to display a decal visible from a point of public access	Ada County ID
Device Operation – NOASH	
24. Require Permanent Installed Alternative Heating Method in Rental Units	Bay Area AQMD CA Klamath County OR Aurora CO
25. Require detailed application or inspection to verify need	Puget Sound CAA WA
26. Require inspection of device and installation	San Joaquin Valley APCD CA
27. Require annual renewal of waiver	Maricopa County AZ
28. Set income threshold	Missoula City-County MT Maricopa County AZ

Table 6. Control Measures Implemented in $PM_{2.5}$ Nonattainment Areas That Have Not Been Implemented in FNSB

Measure Description	Areas Implementing Measure
29. Allow only NOASH households to burn during curtailment periods	Utah, UT
Fuels	
30. Distribution of Curtailment Information at Time of Sale of Wood-Burning Device	South Coast Air Quality AQMD CA, Bay Area AQMD CA
31. Require sale of only dry wood during late summer to end of winter	South Coast AQMD CA
32. Require dry wood to be clearly labeled to prohibit marketing of non-dry wood as dry wood	San Joaquin Valley APCD CA Bay Area AQMD CA
Open Burning	
33. Burn permits required	Klamath County OR Feather River AQMD CA
34. Prohibit burn barrels and other outdoor equipment	Klamath County OR
35. Restrict burning during air pollution events	Ada County ID Klamath County OR
36. Prohibit residential open burning	South Coast AQMD CA
37. Periodic burn windows	Klamath County OR
Curtailment Programs – Averaging Period	
38. Ambient PM2.5 concentration (1-hr average)	Idaho, ID
Curtailment Programs – Thresholds	
39. Use of AQI as Basis for Curtailment Threshold	Idaho, ID
Curtailment Programs – Stages	
40. Single stage ban	Ada County ID Idaho, ID Maricopa County AZ Utah, UT Lane Regional APA OR Feather River AQMD CA Arvada CO Aurora CO
Curtailment Program – Exemptions	
41. Special needs permit	Missoula City-County MT
42. Burn down period	Puget Sound CAA WA Maricopa County AZ
43. Exempt ceremonial or religious fires	South Coast AQMD CA
44. Alternative heating appliance failure	Missoula City-County MT Maricopa County AZ Klamath County OR
45. Elevation-based	South Coast AQMD CA
46. Lack of electrical or natural gas service availability	Utah, UT South Coast AQMD CA

Table 6. Control Measures Implemented in $PM_{2.5}$ Nonattainment Areas That Have Not Been Implemented in FNSB

Measure Description	Areas Implementing Measure
	San Joaquin Valley APCD CA
Curtailment Program – Inspections	
47. Inspection warrants	Aurora CO
Coal	
48. Date certain removal of "coal only heater"	Puget Sound CAA WA
49. Prohibit use of coal burning heaters	Longmont CO
50. Require low sulfur content coal	Missoula City-County MT Puget Sound CAA WA
51. Ultra-low Sulfur Heating Oil	Missoula City-County MT New York, NY Pennsylvania, PA
Used Oil	
52. Operation and sale of small "pot burners" prohibited	Vermont, VT
53. No Sale or Exchange of Used Oil for Fuel, unless it Meets Constituent Property Limits	Vermont, VT
Transportation	
54. Adopt CARB vehicle standards	Pennsylvania, PA Klamath County OR
55. School bus retrofits	Klamath County OR
56. Road paving	Nogales AZ Pinal County AZ Klamath County OR
57. Transportation Control Measures (TCMs)*	South Coast AQMD CA
58. Controls on road sanding and salting	Utah, UT
59. I/M Program*	Pennsylvania, PA

* Measures 57 & 59 are addressed in the Measure R20 Transportation Control Measure feasibility analysis.

EPA provided comments[11] on the draft BACM document in May, 2018 and identified several additional control measures to be addressed in this analysis. In addition, analysis of commercial controls in process at the time of the release of the draft were completed and are included in this analysis. Also, several control measures were identified for consideration during the preparation of this report. Those measures are listed below in Table 7 along with the source of the measure being considered, with the exception of state incinerator controls, none of these measures are included in existing control programs.

[11] Attachment to a letter from Dan Brown to Denise Koch, 5/23/2018, EPA comments on ADEC Preliminary Draft Serious SIP Development materials for the Fairbanks serious PM2.5 nonattainment area.

Table 7. Additional Control Measures Identified in EPA Comments and Related Literature Reviews

Measure Description	Source
60. Vehicle Idling	EPA Comment
61. Fuel Oil Boiler Upgrade – Burner Upgrade/Repair	EPA Comment
62. Fuel Oil Boiler Upgrade – Replacement	EPA Comment
63. Require Electrostatic Precipitators	FNSB
64. Weatherization and Energy Efficiency	EPA Comment
65. Emissions Crossing Property Lines	FNSB
66. Lower Curtailment Threshold	EPA Comment
67. Coffee Roasters	Commercial
68. Charbroilers	Commercial
69. Incinerators	Commercial
70. Used Oil Burners	FNSB

All of the above controls are focused on the reduction of particulate emissions. As noted in the Modeling Chapter of the $PM_{2.5}$ Serious SIP neither VOC nor NOx are significant precursor pollutants in the Fairbanks $PM_{2.5}$ nonattainment area. There is no need to identify control measures for these precursor pollutants. With regard to ammonia, EPA commented that "Unless NH_3 is demonstrated to be insignificant for this area, the serious area plan will need to include an evaluation of NH_3 and potential controls for all source categories including point sources." While a precursor demonstration of NH_3 insignificance is not feasible, a literature search for non-point source ammonia controls found no controls for Fairbanks emission sources. Controls addressing agriculture and animal waste ammonia, the predominant sources in lower-48 communities, are well documented, but those sources do not exist in Fairbanks. Therefore, no ammonia controls have been included in the BACM analysis.

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4. Step 3 – Determine Whether an Available Control Measure or Technology is Technologically Feasible

The third step in the BACM Identification and evaluation process is the analysis of the technological feasibility of each of the candidate measures identified in Step 2. As noted above, it requires the consideration of many factors including impacts on the environment (e.g., air, water, noise, etc.) and energy (e.g., consumption, availability, etc.). Measures targeting area and mobile sources need to consider infrastructure, population size, workforce type and habits, etc. In addition, the critical source parameters needed to assess the impacts of the technology need to be identified (e.g., fuel specifications, travel activity, EPA certification, etc.). A key consideration is whether the identified measure provides an emissions benefit beyond those provided by existing federal, state and local controls (i.e., is it more stringent).

As discussed in Step 2 the approach employed in selecting measures for analysis focused on differences between elements of individual rules implemented in $PM_{2.5}$ nonattainment areas and those currently implemented by the Borough and the State for the Fairbanks $PM_{2.5}$ nonattainment area. This section provides the results of detailed comparisons between the selected candidate measures and existing State regulations to determine if the candidate measures are more stringent and can provide emission reductions beyond those of currently implemented measures. As noted in Step 2 there is overlap between infeasible RACM and Step 2 candidate measures, therefore the number of measures analyzed is less than the total of 99 listed measures (29 RACM & 70 candidate measures identified in other SIPs and programs).

One category of common measures is transportation, which includes 11 separate measures (RACM #'s 20 – 27 candidate #'s 54, 57 and 59); all are analyzed as a single measure R20 (consistent with the approach employed in the RACM technological feasibility analysis). Seven other RACM measures (#'s R2, R3, R8, R13, R14, R19 and R28) are addressed in the analysis of control measures identified in other SIPs. Measure R19, is analyzed as a measure in the BACT report. Adjusting the total of 99 listed measures for the 10 reduced TCMs, 7 controls addressed in other SIPs and 1 measure evaluated as a BACT measures leaves 81 measures for analysis.

The presentation of analysis findings follows a generic format with the following components:

- Measure #, Title
- Implementing Jurisdiction
- Regulation Weblink(s)
- Background
- Analysis
- Conclusion

This format is designed to provide transparency in the information used to prepare the analysis. The weblink(s) allow easy access to the referenced rules discussed in the background and analysis presentations.

Numerous comments were received on measures evaluated in the Draft BACM report. Where appropriate, a summary of those comments is presented in the background discussion of the measures addressed below and the analysis has been modified to address them. Because comments/suggestions/new controls have continued to become available since the preparation of the draft BACM report, an agreement was reached with EPA that no new measures would be considered in this report that became available after the September, 2018 Clean Air Conference in Fairbanks. Thus, measures recommended by Stakeholders, etc. since that time are not addressed in this report. Instead, they are addressed in the Control Strategies Chapter of the $PM_{2.5}$ Serious SIP.

Measure 1: Surcharge on Device Sales

Applicable Jurisdiction(s)

- Washington State

Regulation Weblink(s)

- https://dor.wa.gov/find-taxes-rates/other-taxes/solid-fuel-burning-device-tax

Background

A Washington State regulation imposes a fee upon the sale of solid fuel wood burning devices within the state. This regulation was adopted in or prior to 1987.[12] The fee, originally established at $15/unit, is currently set at $30/unit.[13]

This regulation requires that revenues from the program be used solely for the purposes of public education and enforcement of the solid fuel burning device program," with revenue distributed as follows:

a) 34% of the funds shall be distributed to the Woodsmoke Education Program, run by the state air agency, the Washington Department of Ecology, for the purposes of enforcement and educating the public about the effects of solid fuel heating devices on air quality and methods for achieving better efficiency from solid fuel burning devices; and
b) The remaining 66% of the funds are made available to local air authorities with enforcement programs under the Woodsmoke Enforcement Program on the basis of population.

[12] Washington Laws, 1990, available at http://leg.wa.gov/CodeReviser/documents/sessionlaw/1990c128.pdf?cite=1990%20c%20128%20%C2%A7%206; Accessed 10/10/2017.
[13] Washington State Department of Revenue, available at https://dor.wa.gov/find-taxes-rates/other-taxes/solid-fuel-burning-device-tax; Accessed 10/10/2017.

If a local air authority is not in place, does not implement an enforcement program, or elects not to receive the funds, the funds that would otherwise be distributed under this subsection are transferred to the Department of Ecology. Businesses selling new wood stoves are also required to distribute and explain educational materials.

The biennial 2015-2017 budget for the Washington Department of Ecology estimated an income of $547,000 from the combined Woodsmoke Education and Enforcement Program, with $38,000 being allocated to the Department of Ecology for administration of affected programs and $509,000 allocated to the Air Quality Program. Of this $509,000, 34% (or roughly $173,000) was used to fund the statewide Woodsmoke Education Program. $274,000 of the remaining 66% (or $336,000) was disbursed to local agencies to fund both woodstove education and enforcement grants.[14] (Not all of the available funds are requests.)

EPA commented that implementing a surcharge "may be a helpful way to supplement limited funds. Implementation efforts within the nonattainment area could benefit from $24,000 of additional funding whether used for a code enforcer or other support of the wood smoke programs."

Analysis

Discussions with Washington Department of Ecology staff[15] found that surveys they conducted were not able to clearly estimate emission benefits from state-level education/outreach, nor were they able to provide quantitative estimates of their emission benefits based on how funds were pooled and used by local agencies. Similar findings were confirmed based on communication with the Puget Sound Clean Air Agency, one of the local air authorities that receives funding from the Department of Ecology. They too combine funds received from the Wood Stove Education and Enforcement program with revenues from other sources and use the funding for education and enforcement related to burn restrictions, but they could not easily quantify the benefits of the specific funded programs. In addition, the revenues received from this program by the local agencies are small relative to the funds received from other sources.[16]

Given the co-mingling of monies from device sale surcharges with other funding sources, both Washington State and its local air agencies cannot easily estimate emission benefits attributed to either education or enforcement-related programs.

Another consideration is that DEC has no authority to collect the funds obtained through surcharges. Funds collected from surcharges in Alaska go straight into the state's general fund,

[14] State of Washington Department of Ecology, Budget & Program Overview 2015-2017, available at https://fortress.wa.gov/ecy/publications/documents/1501007.pdf; accessed 10/12/2017.
[15] Personal communication with Stuart Clark, Washington Department of Ecology, 10/12/2017. Personal communication with Matthew Vandrush, Washington Department of Ecology, 10/12/2016.
[16] Personal communication with Amy Warren, Puget Sound Clean Air Agency, October 13, 2017.

they are not allocated to DEC unless the legislature appropriates those funds to the agency. The implementation of this measure would require the annual allocation of the collected funds to DEC for use in enforcement and/or education. The uncertainty of this allocation means that the measure is not permanent and enforceable, and therefore does not support a SIP commitment. The only way that could occur would be through a Constitutional Amendment. Multiple years would be required to obtain such authority.

Conclusion

The timing required to adopt this measure is well beyond the June 9, 2021 requirement for BACM. This measure is not technically feasible to implement by June of 2021 and is dismissed from the BACM analysis.

Measure 2: Prohibit Advertising Used Devices that Do Not Meet Emission Criteria for New Device Sales

Implementing Jurisdiction(s)

- State of Colorado

Regulation Weblink(s)

- https://www.colorado.gov/pacific/sites/default/files/5-CCR-1001-6_1.pdf

Background

Section II of Regulation 4 Limitation on the Sale and Installation of Wood-Burning Stoves states:

> *On and after January 1, 1993 no person shall sell or install a used wood-burning device within those portions of the counties of Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, and Jefferson which are located in the AIR program area, as such area is defined in Section 42-4-304(20)(a) (2006), C.R.S., unless it meets the requirements set forth in Section II.A.*

Section II.A states:

> *No person shall advertise to sell, offer to sell, sell, or install a new wood-burning stove in Colorado unless it has been tested, certified, and labeled for emission performance in accordance with applicable criteria and procedures specified in 40 CFR Part 60 … Section 60.532(a) (2015) and Section (b) or (c) (2015) (emphasis added).*
>
> - *40 CFR Part 60, Section 60.532(a) (2015) - 4.5 g/hr (0.010 lb/hr)*
> - *40 CFR Part 60, Section 60.532(b) or (c) (2015) - 2.0 g/hr (0.0044 lb/hr) using crib wood and 2.5 g/hr (0.0055 lb/hr) using cord wood, both effective in 2020.*

Alaska previously implemented regulations that require wood-fired heating devices including wood stoves, pellet stoves, and hydronic heaters, to be removed from a property before sale, lease, or conveyance in the Fairbanks North Star Borough $PM_{2.5}$ Nonattainment Area unless they are EPA-certified (wood and pellet stoves), have a qualifying Phase 2 "White Tag" (hydronic heaters), and meet current Alaska emission standards. Those regulations, however, did not directly address the advertising restriction imposed by Colorado.

The Borough's air quality code prohibited the installation of unlisted solid fuel burning appliances. The voluntary removal, replacement and repair program required applicants to remove and deliver the appliance to an authorized decommission station and deliver a certificate of destruction to the Borough. Borough regulations also prohibited the use of unlisted solid fuel burning appliances during State 1 Alerts. All of these regulations were removed following voter approval of the Home Heating Reclamation Act.

EPA commented that Stage 1 Alerts were referred to multiple times and asked that the analysis clarify whether the measure applied during all stages of the Alert and the level of control with each stage. As noted above the referenced Borough stage restrictions no longer apply.

Analysis

To address Colorado's advertising restriction, a new regulation 18 AAC 50.077(k) has been implemented. It bans advertising of wood-fired heating devices not meeting regulations within the nonattainment area and is independent of stage restrictions (addressing EPA's comments).

Conclusion

The adoption of the referenced state regulation is sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 3: Require Building or Other Permit

Implementing Jurisdiction(s)

- Missoula City-County, Ada County, Klamath County

Regulation Weblink(s)

- https://www.missoulacounty.us/home/showdocument?id=8452
- http://www.sterlingcodifiers.com/codebook/index.php?book_id=447
- http://www.co.klamath.or.us/EH/Air%20Quality%20&%20Burning/Klamath%20County%20Clean%20Air%20Ordinance.htm

Background

Missoula City-County MT requires Installation Permits for the installation of solid fuel burning devices (SFBD) and allows Installation Permits only for pellet stoves in the Air Stagnation Zone (Section 9.203.1.a).

Ada County ID requires a solid fuel heating appliance permit for the installation of a SFBD in any new or existing building (Section 5-10-10.A). Solid fuel heating appliance permit are authorized only for clean burning appliance, which are defined as appliances certified under either the Oregon DEQ or U.S. EPA regulations and placed on the list of approved appliances by Ada County Development Services (Sections 5-10-4 and 5 10 11.A).

Klamath County OR requires a permit from the County Building Division for the installation of a solid fuel-fired appliance (Section 406.100.3.a.iii). Only appliances certified by the Oregon DEQ or U.S. EPA, and appliances that are designated exempt from Oregon DEQ or U.S. EPA regulations, are allowed to be installed with a Building Division permit (Sections 406.005.10, 406.005.12, 406.100.3.a.i, and 406.100.3.a.ii).

While the Borough had regulations governing installation permits, they were removed with the passage of the Home Heating Reclamation Act. The state had no regulations addressing installation permits.

Analysis

The Missoula City-County, Ada County, and Klamath County regulations require permits for the installation of SFBAs in any structure. Recognizing the need for equivalent regulations, the state has implemented a new regulation 15 AAC 50.077(j)(2), referenced in the introduction, that restricts approved wood-fired heating devices from being either the primary or only source of heat in new construction, except for a “dry cabin” on 2+ acre parcels or rental units unless the heating device already existed prior to the new regulation and they qualified for a NOASH waiver.

Conclusion

The adoption of the referenced state regulation is sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 4: Require Confirmation of Proper Installation by Requiring Professional Installation or On-Site Inspection

Implementing Jurisdiction(s)

- San Joaquin Valley APCD

Regulation Weblink(s)

- http://www.valleyair.org/rules/currntrules/r4901.pdf

Background

San Joaquin Valley APCD requires that applications for wood burning device registration contain certifications by District Registered Wood Burning Heater Professionals verifying that the wood burning heaters meet device eligibility requirements (Sections 4901.5.7.3.1.2).

Fairbanks had a regulation which required installations of solid fuel burning appliances in new construction and replacement appliances in subsidized change-outs be performed by Borough-listed vendor/installers using Borough-listed appliances. Those regulations, however, were removed with the passage of the Home Heating Reclamation Act and the state had no regulations addressing professional installation confirmation or on-site inspection.

Analysis

The San Joaquin Valley measure requires that devices applying for registration be inspected by District-registered professional to confirm that the devices are District-listed as low emission units. Recognizing the need for professional installation of wood-fired heating devices and wood-fired retrofit control devices and confirmation of those installations, the state has implemented new regulation subsection 15 AAC 50.077(i). As noted in the introduction, this subsection directly addresses those requirements.

Conclusion

The adoption of the referenced state regulation is sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 5: Register/Require Industry Certification of Heating Professionals

Implementing Jurisdiction(s)

- San Joaquin Valley APCD

Regulation Weblink(s)

- http://www.valleyair.org/rules/currntrules/r4901.pdf

Background

San Joaquin Valley APCD requires that applications for wood burning device registration and registration renewal contain certifications by District Registered Wood Burning Heater Professionals (Rule 4901 Sections 5.7.3.1.2 and 5.8.2.1). Section 5.10 of the Rule specifies the

requirements for registration by the District of Wood Burning Heater Professionals. The primary requirement is to hold a current Fireplace Investigation Research and Education Certified Inspector registration, Chimney Safety Institute of America certificate, or National Fireplace Institute certificate.

Fairbanks had a regulations requiring installations of solid fuel burning appliances in new construction and replacement appliances in subsidized change-outs be performed by Borough-listed vendor/installers using Borough-listed appliances. Those regulations, however, were removed with the passage of the Home Heating Reclamation Act and the state had no regulations addressing professional installation confirmation or on-site inspection.

Analysis

Lacking a regulation governing the certification of heating professionals, the state has implemented new regulations 18 AAC 50.077(i)(1) and (2)requiring the certification of installers by the National Fireplace Institute or Masonry Heaters Association as appropriate.

Conclusion

The adoption of the referenced state regulation is sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 6: Prohibit Installation of Flue Dampers Unless Device was Certified Using Flue Damper

Applicable Jurisdiction(s)

- Missoula, Montana

Regulation Weblink(s)

- https://www.missoulacounty.us/home/showdocument?id=8452

Background

With respect to enclosed combustion devices, the term “draft” refers to the negative pressure created at the air inlet to the combustion chamber by the buoyancy of hot combustion gases exiting the combustion chamber through a vertical stack or chimney. The magnitude of stack draft is primarily governed by the difference in temperature between outdoor air and the combustion gases within the stack, and the volume of the stack (or chimney). Since outdoor air and stack gas temperatures change both seasonally and during a typical diurnal heating cycle, the amount of draft can vary similarly.

In residential wood stoves and inserts, inlet air and combustion gas flow rates are generally controlled by a damper installed at the inlet air ports to the combustion chamber. Where

building codes and wood burning regulations allow, dampers can also be installed downstream of the combustion chamber in the exhaust stack to directly regulate combustion gas flow rates. Many dampers require manual adjustment, but some are thermostatically controlled to open the damper when combustion chamber temperatures decline during the burndown phase.

Solid fuel burning appliances are designed to operate within an optimum draft range. If the draft is set too low, insufficient air is available to sustain combustion except when very small quantities of fuel are present in the combustion chamber. If the draft is set too high, excess air (beyond what is needed for proper combustion) is allowed into the combustion chamber which reduces combustion temperatures and reduces the device's heating efficiency (resulting in increased fuel use) and may also result in unsafe operation. The optimum range of draft for properly installed and operated residential wood-burning devices such as wood stoves and fireplace inserts typically falls in the negative pressure range of minus 0.04 to 0.08 inches of water column.

EPA commented "The discussion of Measure 6 may need additional documentation. Anecdotal evidence is that damping is common in Fairbanks and is potentially a bigger source of pollution than not having a damper at very cold conditions. If installation by a certified technician addresses this issue that should be documented."

Analysis

Missoula, Montana is the only jurisdiction to enforce a regulation prohibiting the installation of a flue (exhaust stack) damper unless the device is specifically certified with a flue damper. The staff from the Montana Department of Environmental Quality could not locate a staff report associated with the adoption of this regulation by their Board in 1986 as part of the Montana Clean Air Act. They also suggested that no analysis was conducted to review the likely impact of flue damper installation on emissions prior to adoption.[17]

During wintertime conditions in Fairbanks flue draft varies dramatically beyond the optimal range due to wider temperature differences between flue gases and ambient air. When outdoor temperatures fall to the -10 to -20°F range typical of ambient $PM_{2.5}$ violations in Fairbanks, draft negative pressures can reach or exceed minus 0.20 inches of water column, which is well in excess of the typical design ranges for wood stoves and inserts.[18] Under these conditions, resident time of hot combustion gases in a wood stove or fireplace insert will be reduced, increasing the quantity of fuel needed to be burned to maintain the target indoor temperature. Thus, use of a flue damper will reduce inlet air and exhaust gas flowrates and the resulting draft to within the designed operating ranges of woodstoves and fireplace inserts and provide an emissions reduction benefit through reduced fuel consumption. With regard to the installation of new wood burning devices, the 2015 NSPS mandates that owner manuals specify whether flue dampers are required and professional installers are required to observe installation instructions.

[17] Personal communication with Julie Mohr, Montana Department of Environmental Quality, October 5, 2017; Personal communication with Benjamin Schmidt, Missoula City/County Health Department, October 6, 2017.
[18] Personal communication with Kent Severns, The Woodway, Fairbanks, AK, October 6, 2017.

If required, 18 AAC 50.077(j) requires the use of installers certified by the National Fireplace Institute and/or the Masonry Heaters Association as appropriate, which addresses EPA's comment.

Conclusion

The benefits of this measure in an arctic environment are likely to increase emissions through increased fuel combustion. Thus this rule will produce no benefit for new installations; therefore the measure is technologically infeasible and not eligible for consideration as BACM.

Measure 7: Require Devices Meet Stricter Emission Criteria in High Pollution Zones

Implementing Jurisdiction(s)

- Missoula City-County MT

Regulation Weblink(s)

- https://www.missoulacounty.us/home/showdocument?id=8452

Background

The Missoula City-County wood heating control regulations require installation permits for the installation and use of all wood heating devices after July 1, 1986 in the Air Stagnation Zone (Section 9.202.1) and May 14, 2010 in the remainder of Missoula County (Section 9.202.2). The categories of devices authorized for installation differ between the two areas. Within the Air Stagnation Zone, installation permits are authorized only for pellet stoves emitting no more than 1.0 gm/hr (Section 9.203.1.a). In the remainder of Missoula County, installation permits can be issued to devices complying with 40 CFR 60 AAA (effective February 26, 1988), pellet stoves emitting no more than 4.1 gm/hr, and outdoor wood-fired hydronic heaters emitting no more than 7.5 gm/hr (Section 9.204.1.a-d).

Fairbanks enforced a single set of approved device types for installation within the nonattainment area. The regulations addressing this requirement was removed with the passage of the Home Heating Reclamation Act and the state had no regulations addressing installation permits.

Analysis

The current test method that results in the certification value (grams/hr) averages emissions over four steady-state runs. The values from each of these runs is an average emission rate over the time it takes to burn 100% of the full load of wood used for each run. This approach translates into a certification value that is an average of an average. Averaging results multiple times minimizes emission rates, which results in certification values that may vastly under predict

actual in-use emission rates and does not reflect the fuel loading events that in field use may occur multiple times per day.

Real-time PM measurements collected from EPA certification tests have shown that the maximum emission rate occurs within two hours of the test period, and typically, on average, appliances spend approximately 50% of the certification testing time in the period known as the charcoal tail, where virtually no emissions occur, and in some cases filters may experience particulate loss due to warm dry air blowing through the filter.

Given the likely under predicting of actual in-use emissions through the current certification method, ADEC proposed utilizing the TEOM for non-catalyst devices and plans to use the emission profiles to assist in ensuring performance and identifying actual emissions through the certification process. ADEC felt that additional scrutiny of actual emissions would provide more insight than the average of an average value. However, many adverse comments to using the TEOM (and differentiating certification standards by device type) were received. Under the 2015 NSPS, EPA required reporting of emission rates for the first hour of the test period. This data reflects the timing and emission rates typically associated with the 60-minute test requirements for PM testing at all other sources (EPA Method 5). Assessment of one-hour data allows agencies to gauge performance and determine which appliances are low emitting from the start of the certification test versus those that have been able to design for long charcoal tails to minimize the peak emissions.

Based on a review of current certified wood heaters, the Missoula County measure requiring a 1.0 grams/hour emission standard essentially results in a pellet fueled device only requirement. In looking at pellet-only requirements for the FNSB nonattainment area, public concerns are often expressed about a fear of losing heat during power failure and pellet devices require electrical power to operate. Thus, DEC's proposal to include the TEOM was derived as an alternative that may produce similar emissions benefits while allowing access to a broader array of wood heaters.

In light of the comments received, DEC has analyzed over 60 EPA approved certification reports, focusing on the one-hour filter data measurement results. After this review, ADEC decided in its final regulation to provide an alternative to the TEOM test method that will address many of the comments received while still providing an equivalent, if not better, air quality result than the 1.0 grams/hr Missoula emission standard. In the final regulation, manufacturers may provide the TEOM data as originally proposed with the additional specificity that no rolling 60-minute period may exceed 4.0 grams/hr or they may meet the requirement to be a DEC listed device by providing data that shows that no valid 1-hr filter measurement from the certifying report is greater than 6.0 grams/hr. While this is 3 times the final DEC standard (certification value of 2.0 grams/hour or less), this will be applied to all woodstoves (not just non-catalytic), and will reduce the number of allowable devices into the area while still allowing more device types than just pellet fueled. This approach should ensure that performance of the devices under real world operation will be more consistent because the emission standard value is not an average and, as more data becomes available, it is possible that the criteria for an acceptable 1-hr filter measurement could be lowered to further improve emission benefits.

Existing state regulations specified emission rate criteria for heating devices installed in the nonattainment area, however, the state has implemented new regulations 18 AAC 50.077(b),(c), (d) and (e), which specify more stringent EPA and Alaska emission rates that new heating devices must meet in order to be installed. Collectively, these regulations exceed the Missoula City-County wood heating control regulation requirements.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 8: Prohibit Installation of Solid Fuel Heating Device in New Construction

Implementing Jurisdiction(s)

- South Coast AQMD, Bay Area AQMD

Regulation Weblink(s)

- http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-445.pdf?sfvrsn=4
- http://www.baaqmd.gov/~/media/files/planning-and-research/rules-and-regs/reg-06/rg0603.pdf?la=en

Background

The South Coast Air Quality Management District prohibits the installation of a wood-burning device into any new construction (Section 445.d.1) except in new developments where no natural gas service exists within 150 feet of the property line (Section 445.f.2). Devices installed in new construction without natural gas service are limited to USEPA certified wood-burning heaters, pellet stoves, masonry heater, or dedicated gaseous-fueled fireplaces (Section 445.d.2). South Coast AQMD does not require a permit for device installation or operation.

Bay Area Air Quality Management District prohibits the installation of a wood-burning device in any new construction building effective November 1, 2016 (Section 6-3-306). The Bay Area regulation does not provide an exemption from this requirement in areas not served by natural gas infrastructure.

Fairbanks had regulations addressing the installation of solid fuel devices in new construction, but they were removed with the passage of the Home Heating Reclamation Act. The state had no regulations governing installation of wood-burning devices in new construction.

Analysis

While Fairbanks currently has natural gas service, it is capacity constrained and will not be in a position to expand service to new customers until 2020 (i.e., after the designated attainment year).[19] As a result, the installation requirements in the South Coast rule that would be applicable if adopted by the state would be limited solely to the type of device installed.

As noted in Measures 3, 4, 5 and 7, the state has implemented new regulations that establish more stringent emission ratings for new heating devices and related installation requirements. Those regulations, however do not prohibit the installation of wood-burning devices in new construction. Backup heating systems are essential for survival in an arctic environment as loss of primary heating is not an uncommon occurrence with many causes including: extreme cold temperatures, ice storms, fuel supply loss, etc.

ADEC often hears from FNSB residents who have significant concerns regarding the need for non-electric backup heating systems in their homes. Given the subarctic climate and periodic power failures, these individuals have real safety concerns for themselves and their families as well as concerns about damage to their property.

These concerns and expressed needs for reliable backup heat are likely very different in the FNSB nonattainment area than in the San Francisco Bay Area where the BACM prohibition originates. However, based on the Borough's woodstove changeout/conversion program it is technically feasible to design a new home with adequate backup heating systems that do not rely on solid fuel heating appliances.

Even though it may be technically feasible in certain situations, without widespread availability to natural gas there are limited technologies to provide backup heat to address the safety concerns. While voluntary programs are in place, only 12 emergency power back up systems have been installed through the Borough's program. With the limited number of actual installations, ADEC is cautiously optimistic that the emergency power back up systems will become a proven technology, but at this point the limited installations do not demonstrate that this technology is feasible in every situation. Due to the importance of these systems to ensure citizens safety in an arctic climate, it is not prudent to exclude an entire sector of proven residential heating technology that many citizens rely on for an immediate safety concern.

Conclusion

While this measure is technologically feasible, an economic analysis of its cost effectiveness, presented in Step 4, shows that it is economically infeasible in an arctic environment.

[19] AIDEA IGU Financing Agreement op. cit., Appendix A

Measure 9: Limit the Density of Solid Fuel Heating Devices in New Construction

Implementing Jurisdiction(s)

- San Joaquin Valley APCD, Eastern Kern APCD

Regulation Weblink(s)

- https://www.valleyair.org/rules/currntrules/r4901.pdf
- http://www.kernair.org/Rule%20Book/4%20Prohibitions/416_1%20Wood%20Burning%20Heaters%20and%20Fireplaces.pdf

Background

The San Joaquin Valley Air Pollution Control District in California limits the number of wood burning heaters allowed in new residential developments. Two limits apply to developments with housing densities greater than 2 residences per acre: no wood burning fireplaces may be installed in these residences, and no more than two U.S. EPA Phase II-certified wood heaters may be installed per acre in these residences. For developments with housing densities less than or equal to two residences per acre, the regulation allows no more than one wood burning fireplace or U.S. EPA Phase II-certified wood heater per residence. (Section 4901.5.3.2)

The Eastern Kern Air Pollution Control District in California prohibits the installation of wood burning fireplaces in new residential subdivisions that consist of 10 or more dwellings. (Section 416.1.VI)

Fairbanks allowed for the installation of solid fuel burning devices in new construction provided that permits had been issued by the Borough, devices were Borough-listed, and installation was performed by a Borough-listed installer, among other requirements. These regulations were removed after passage of the Home Heating Reclamation Act.

Analysis

Alaska DEC does not have the information or programs to address land use authority required to limit the number of solid fuel burning devices that can be installed in single dwellings newly constructed, nor limit the number of devices that can be installed per acre in new residential developments. Multiple years would be required for DEC to gather data and evaluate options, possibly obtain necessary authority, and establish the regulatory requirements to implement this measure.

Conclusion

The timing required to adopt this measure is well beyond the June 9, 2021 requirement for BACM. This measure is not technically feasible to implement by June of 2021 and is dismissed from the BACM analysis.

Measure 10: Install EPA-Certified Device Whenever a Fireplace or Chimney is Remodeled

Implementing Jurisdiction(s)

- Bay Area AQMD

Regulation Weblink(s)

- http://www.baaqmd.gov/~/media/files/planning-and-research/rules-and-regs/reg-06/rg0603.pdf?la=en

Background

The Bay Area AQMD requires that a gas-fueled, electric, or EPA-certified device be installed whenever a fireplace or chimney is remodeled at a cost that exceeds $15,000 and requires a local building permit (Section 6-3-307).

Fairbanks limited wood heating devices in new construction to Borough-listed appliances (Section 21.28.030E), but did not require the replacement of non-Borough-listed appliances with listed versions upon the remodeling of a residence or of a fireplace or chimney. These regulations were removed after passage of the Home Heating Reclamation Act.

Analysis

The Bay Area AQMD measure would require the upgrading of wood heating appliances in affected Borough residences in which remodeling projects included fireplace or chimney modifications that exceeded $15,000 in cost. Alaska DEC does not have the information or programs to address land use/building code authority needed to govern building/remodeling permits. Multiple years would be required for DEC to gather data and evaluate options, possibly obtain necessary authority, and establish the regulatory requirements to implement this measure.

Conclusion

The timing required to adopt this measure is well beyond the June 9, 2021 requirement for BACM. This measure is not technically feasible to implement by June of 2021 and is dismissed from the BACM analysis.

Measure 11: Prohibit Use of Rain Caps on Stacks

Implementing Jurisdiction(s)

- State of Maine

Regulation Weblink(s)

- https://www1.maine.gov/sos/cec/rules/06/096/096c150.doc

Background

Outdoor wood boilers (OWBs) are generally used to provide heat for residential structures. Firewood is burned in the unit, sited outside the residence, with the energy released by combustion transferred to the residence through circulation of a thermal fluid.

In some locations, operators of outdoor wood boilers attach a rain cap (or weather cap) to the stack from which emissions produced by the outdoor wood boiler are released. This rain cap is attached to prevent moisture (rain, snow, etc.) from entering the stack during periods of non-operation and causing exposed surfaces to rust.

EPA commented that the quote "did not know if the rule worked well" needs a reference. Also EPA expressed concern about how the performance of a control measure in Maine makes it technologically infeasible in Fairbanks.

Analysis

Maine is the only jurisdiction that currently enforces a regulation related to the use of rain caps on outdoor wood boiler stacks, prohibiting the installation of caps unless specifically required by the manufacturer of the boiler.[20] Personal communications with staff members of the Maine Department of Environmental Protection indicated that the regulation was adopted in Maine between 2007 and 2008 primarily in response to complaints from citizens about the use of boilers by neighbors.[21] More than one staff member indicated that no scientific or statistical analysis was conducted by the staff during development of the regulation. One said specifically that he "did not know if the rule had worked well," and one said that only one comment was entered into testimony in the meeting at which the Maine DEQ Board adopted the regulation; the only responsive in the record mentioned that the use of a rain cap impeded buoyant plume rise of smoke exiting a stack and resulted in higher ground-interior level impacts at downwind residences. [22]

The average precipitation rate in Fairbanks is much lower than that of Maine, particularly in the winter months. Whereas Maine averages more than forty inches of precipitation per year,

[20] Regulation can be downloaded at http://www.maine.gov/dep/air/woodsmoke/woodcombustion.html

[21] Personal communication on October 4, 2017 with Jeff Crawford, Air Bureau, Maine Department of Environmental Protection; Personal communication on October 5, 2017 with Tom Graham, Air Bureau, Maine Department of Environmental Protection.

[22] Personal communication on October 4, 2017 with Jeff Crawford, Air Bureau, Maine Department of Environmental Protection; Personal communication on October 5, 2017 with Tom Graham, Air Bureau, Maine Department of Environmental Protection.

Fairbanks averages less than eleven.[23,24] In addition, whereas ~54%, or 22 inches, of Maine's precipitation falls during the winter nonattainment months (October through March), only 31%, or 3 inches, of precipitation in Fairbanks falls during those months. Discussions with Fairbanks North Star Borough Air Quality Program staff found that rain caps are not used in Fairbanks, and thus a regulation prohibiting rain caps would have no impact on emissions;[25] thus, addressing EPA's concerns.

Conclusion

The prohibition of rain caps by Maine DEC was intended to improve smoke dispersion, not reduce emissions. Because of the very low inversion heights that are experienced in Fairbanks during the winter heating season, a prohibition of rain caps would not improve plume dispersion in the vertical direction, much less reduce emissions. Since the need for rain caps in Fairbanks is limited and Borough staff have previously indicated that existing OWBs are not equipped with them, a regulation prohibiting rain caps on OWB stacks would produce no emission benefit and is therefore technologically infeasible and not eligible for consideration as BACM.

Measure 12: Require Minimum Stack Height for OWBs Relative to Nearby Rooflines

Applicable Jurisdiction(s)

- State of Maine

Regulation Weblink(s)

- http://www.maine.gov/dep/air/woodsmoke/woodcombustion.html

Background

Outdoor wood boilers (OWBs) are generally used to provide heat for residential structures. Firewood is burned in the unit, located outside the residence, with the energy released by the combustion process transferred into the interior of the residence through circulation of a thermal fluid.

The boilers generate emissions by the combustion of wood fuel, and those emissions can be transported to impact neighboring residences. Ground-level concentrations of emissions at

[23] Data collected for Portland, ME; Augusta, ME; and Lewiston, ME from U.S. Climate Data at https://www.usclimatedata.com/climate/maine/united-states/3189; Accessed 10/12/2017.
[24] Data collected for Fairbanks, AK from U.S. Climate Data at https://www.usclimatedata.com/climate/fairbanks/alaska/united-states/usak0083; Accessed 10/12/2017.
[25] Personal communication with Todd Thompson, Fairbanks Borough Air Quality Department, October 10, 2017.

downwind residences can be influenced by the heights at which emissions exit exhaust stacks and whether wind flows at exit points are impacted by the heights of structures near these exhaust stacks.[26]

Maine is the only state that currently regulates the minimum height of exhaust stacks serving newly-installed OWBs. The regulation specifies a minimum stack height of ten feet or "two feet higher than the peak of the roof of the structure being served by the OWB" if:

1) the OWB has a particulate emission rating greater than 0.60 lbs/MMBtu and is within 500 feet of any nearby residence, or
2) the OWB has a particulate emission rating of 0.60 lbs/MMBtu or less and is within 300 feet of any nearby residence.[27]

Additionally, the regulation requires the extension of an existing OWB exhaust stack if a new residence is constructed within the setback distances specified in the regulation.

Analysis

As with the Maine-only regulation prohibiting the use of rain caps on OWB exhaust stacks, staff members of the Maine Department of Environmental Protection reported that the regulation was adopted in Maine between 2007 and 2008 primarily in response to nuisance complaints from citizens about the use of OWB by neighbors.[28] More than one staff member indicated that no scientific or statistical analysis was conducted by the staff during development of the regulation to estimate its benefits. One said specifically that he "did not know if the rule had worked well," and one said that no public comments were received in relation to the stack height requirements prior to or during the public hearing at which the Maine DEQ Board adopted the regulation.

Maine adopted this rule to minimize disputes between neighbors; the rule has no effect on emissions and was not developed to reduce ambient $PM_{2.5}$ concentrations other than at nearby downwind residences. The rule predates federal regulation of OWBs, which mandates that owner manuals provide "guidance on proper installation information, including stack height".[29] A survey of owner manuals found installation instructions specifying that chimney height extend above the roofs of surrounding buildings. [30] Industry guidance contained in Best Burn Practice

[26] Minnesota Pollution Control Agency, AERMOD Evaluation of Outdoor Wood Boiler Stack Height and Setback
[27] Regulation can be downloaded at http://www.maine.gov/dep/air/woodsmoke/woodcombustion.html
[28] Personal communication on October 4, 2017 with Jeff Crawford, Air Bureau, Maine Department of Environmental Protection; Personal communication on October 5, 2017 with Tom Graham, Air Bureau, Maine Department of Environmental Protection.
[29] https://www.federalregister.gov/documents/2015/03/16/2015-03733/standards-of-performance-for-new-residential-wood-heaters-new-residential-hydronic-heaters-and
[30] https://centralboiler.com/media/1803/9000166_manual_classic_27-jan-2014.pdf

for Wood Burning Outdoor Furnace recommends that stack extend 2 feet above surrounding roof top peaks.[31]

The addition of a regulation specifying minimum stack heights for OWBs would not lead to a reduction in $PM_{2.5}$ emissions but could reduce $PM_{2.5}$ concentrations downwind of newly-installed OWBs or newly-constructed residences near OWBs.

Conclusion

Because of the lack of any emission reduction resulting from adoption of a minimum stack height regulation, this measure is technologically infeasible and not eligible for consideration as BACM.

Measure 13: Submit Sale and Installation Information to Air Program

Implementing Jurisdictions

- State of New York

Regulation Weblink(s)

- https://govt.westlaw.com/nycrr/Browse/Home/NewYork/NewYorkCodesRulesandRegulations?guid=I591033205f9311e0b70f0000845b8d3e&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)

Background

The New York Department of Environmental Conservation requires the distributor of new outdoor wood boilers (OWB) to provide prospective buyers with a written notice of fuels allowed to be burned in OWBs and a statement that OWBs cannot be operated in locations where emissions unreasonably interfere with the public health of and enjoyment of property by others (6 CRR-NY 247.9.a). This regulation also requires the distributor to submit to the Department a statement signed by the OWB buyer acknowledging receipt of the written notice provided by the distributor and containing information on the location, manufacturer, stack height, and distance to the nearest property boundary of the installed OWB (6 CRR-NY 247.9.b). To be certified for sale in the State of New York, OWBs must be certified to emit not more than 0.32 lb/MMBTU $PM_{2.5}$ using year-round weighting factors specified in the listed test method (6 CRR-NY 247.5.a). OWBs must be installed at least 100 feet from the nearest property boundary (6 CRR-NY 247.5.b).

31 https://www.hpba.org/Portals/26/Documents/Government%20Affairs/NSPS%20Members/HPBA%202014%20NSPS/Attachment13TechEnvironmentalAirDispersionModelingReportofEClassic2300July2012.PDF?ver=2016-11-21-105529-197

Fairbanks had regulations requiring commercial sellers of solid fuel burning appliances to provide the prospective buyer with a written notice that summarizes Borough fuel restrictions; installation, property location, operation and maintenance requirements, and an advisory that installation in some areas may not be appropriate. Those regulations disappeared with the passage of the Home Heating Reclamation Act. The state had no regulations governing home heating installation requirements or related information disclosure.

EPA commented that the analysis "identified that no SIPs existed or EPA guidance/requirements for the measure and incorrectly used that rationale as the conclusion for not considering the measure".

Analysis

The New York DEC measure allows for the installation of OWBs emitting 0.32 lb/MMBTU $PM_{2.5}$ or less, whereas new state regulation 18 AAC 50.077(a) prohibits the sale of non-pellet fueled hydronic heaters. Subsection (b) requires pellet fueled hydronic heaters must be certified to 0.10 lb/MMBTU or less to be installed in new construction. Subsection (h) requires wood heating devices to be registered prior to closing, if the device is to be sold, leased or conveyed. Subsection (l) requires hydronic heaters not meeting this requirement must be rendered permanently inoperable by December 31, 2024. Another new subsection 18 AAC 50.077(k)(2) requires curtailment information and proper operating instructions to be conveyed at the time of sale. Subsection (i) requires installers to provide confirmation to ADEC that wood heating devices were properly installed. While the new state regulations do not require a signed statement from the buyer acknowledging receipt of information on fuels to be burned and location restrictions, the pellet restriction for new hydronic heaters trumps the need for information on fuels to be burned. With regard to the setback requirement from the nearest property boundary, 18 AAC 50.077(j)(1) restricts installation of pellet fueled hydronic heaters to more than 330 feet from the closest property line or more than 660 feet from a school, clinic, hospital, or senior housing unit, which is much more stringent than the 100 foot setback requirement established by New York. An additional consideration is that, the setback requirement has no effect on the emission rate, which will be significantly lower than mandated by New York.

EPA's concerns are addressed the through the adoption of the regulations noted above.

Conclusion

The adoption of the referenced state regulation is sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 14: Require Installation of Thermal Mass to Improve Efficiency and Prevent Frequent Cycling in Selected New Units

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- None

Background

The initial review of applicable SIPs and EPA guidance documents mistakenly identified a measure requiring the installation of thermal mass to prevent frequent burn cycling in hydronic heaters.

Analysis

A review of the literature, applicable SIPs, EPA guidance documents, hydronic heater certification documents and the final rule for hydronic heaters issued in 2015 (Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces)[32] could find no requirements for installing thermal mass in hydronic heaters. The final rule for hydronic heaters and forced air furnaces discussed concerns about cycling conditions, operations, etc., but included no requirement for the addition of thermal mass to reduce cycling. The limited detail provided with this measure, along with the findings of the literature review, do not support any quantifiable permanent and enforceable emission reductions.

Conclusion

40 CFR 51.100 defines BACM as a control measure that "generally can achieve greater permanent and enforceable emission reductions … than can be achieved through implementation of RACM". This measure cannot achieve permanent and enforceable emission reductions greater than can be achieved through implementation of RACM, does not meet the definition of BACM and is dismissed from the BACM analysis.

Measure 15: Disclosure of Devices on Property Sale

Implementing Jurisdiction(s)

- Lane Regional APA

Regulation Weblink(s)

- https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=1567

[32] https://www.gpo.gov/fdsys/pkg/FR-2015-03-16/pdf/2015-03733.pdf

Background

The Lane Regional Air Protection Agency enforces regulations adopted by the State of Oregon with respect to the transfer of residential property containing SFBDs. Oregon Administrative Rule 340-262-0700 requires the removal and destruction of all devices not certified for sale as new by the Oregon Department of Environmental Quality or the USEPA, and those devices not permanently labeled as certified, upon the transfer of residential property. This Rule also requires disclosure to Oregon Department of Environment Quality of the removal and destruction of uncertified devices. The Rule does not exempt uncertified devices in NOASH households from removal and destruction requirements. Certified devices are defined in Oregon Administrative Rule 340-262-0500 as devices certified by USEPA as of July 1, 2010. The USEPA certification PM2.5 emission limits in 2010 were 4.1 gm/hr for catalyst-equipped wood stoves and 7.5 gm/hr for non-catalyst wood stoves.

Previous Alaska regulations prohibited the conveying of ownership of any wood stove not certified by USEPA to meet a PM2.5 emission limit of 2.5 gm/hr in the Fairbanks nonattainment area as part of a property sale (Section 18 AAC 50.077.c). As this emission limit is more stringent than 2010 USEPA certification standards, the ODEQ measure is less stringent than existing Fairbanks regulations with respect to wood stove removal upon the transfer of residential property ownership. Those regulations have been repealed and replaced.

Prior to approval of the Home Heating Reclamation Act, Fairbanks prohibited the installation of a solid fuel burning appliance in new construction without an installation permit issued by the Borough (Section 21.28.030.E.1.a). Fairbanks also prohibited the sale of appliances not certified by USEPA to meet a $PM_{2.5}$ emission limit of 2.5 gm/hr unless the buyer signs an affidavit attesting that the appliance will not be installed or used in the nonattainment area, and submits the affidavit to the Borough. These regulations were removed from Borough Code following voter approval of the Home Heating Reclamation Act.

EPA commented that (1) the discussion of Measure 15 did not clearly state how Alaska would ensure devices are taken out at the point of sale, (2) the process for ensuring that NOASH applications did not involve a stove that should have been taken out at the point of sale and (3) there was confusion about the threshold for NOASH eligibility.

Analysis

The Oregon DEQ regulation causes devices certified by USEPA to meet $PM_{2.5}$ emission limits up to 7.5 gm/hr to remain in residences during property transfers. By comparison, Alaska's new regulation 18 AAC 50.077(a) specify that a person may not install, reinstall, sell, lease, distribute, or convey wood-fired heating devices that lack a valid EPA certification under 40 C.F.R. 60.533 or any wood-fired outdoor hydronic heaters, except pellet fueled devices. 18 AAC 50.077 (l) requires owners to render all noncompliant devices permanently inoperable by December 31, 2024. The new state regulation 18 AAC 50.077(h) requires owners to register devices upon sale or conveyance, prior to closing if being sold, when applying for a waiver, to participate in Burn Right and woodstove change out or conversion programs and prior to close out of enforcement actions. Collectively, the above mandates in the new Alaska regulations are

more stringent than the removal, destruction and confirmation requirements contained in the Oregon DEQ regulations.

In response to the EPA comments, the above discussion addresses concerns about how devices are taken out at the point of sale. With regard to the NOASH applications and eligibility concerns the new Alaska regulations offer no exemptions for NOASH compliant devices. The only exemptions are for those receiving temporary waivers and the transfer of devices outside of the nonattainment area as defined in the Emergency Episode Plan.

Conclusion

The adoption of the referenced state regulation is sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 16: Require Notice and Proof of Destruction or Surrender of Removed, Uncertified Devices

Implementing Jurisdiction(s)

- Puget Sound CAA

Regulation Weblink(s)

- https://www.pscleanair.org/DocumentCenter/Home/View/557

Background

The Puget Sound Clean Air Agency in the State of Washington required the removal of, or modification to render permanently inoperable, all uncertified wood stoves in residences and commercial establishments within the Tacoma, Pierce County $PM_{2.5}$ nonattainment area by January 1, 2015. (Section 13.07.a.1) To assure compliance, the agency also required the person removing or modifying an uncertified wood stove to provide to the agency documentation of the removal and disposal or rendering permanently inoperable of each affected device. Documentation of such actions must conform to agency requirements and procedures and be provided to the agency within 30 days of wood stove removal or modification. (Section 13.07.a.4)

During a first stage of impaired air quality as declared by PSCAA, all solid fuel burning devices within the affected geographical area must cease operating except for (a) nonaffected pellet stoves; (b) wood stoves certified under 40 CFR 60 Subpart AAA (7/1/1990); wood stoves meeting Oregon DEQ Phase 2 emission standards (November 1984); (c) solid fuel burning devices certified by Washington Department of Ecology, or devices in residences or commercial buildings deemed exempt from curtailment requirements by PSCAA due to having no other adequate source of heat (NOASH). (Section 13.05.a.1, 13.05.d.1)

Fairbanks had no requirement to remove uncertified wood stoves by a fixed date, but did prohibit their use during a Stage 1 Alert. Those requirements disappeared with the approval of the Home Heating Reclamation Act. Alaska had no regulations addressing the removal, proof of destruction or surrender of uncertified devices.

EPA commented that the Tacoma and Pierce County removal requirements appeared more stringent than those in the Moderate SIP approved Fairbanks ordinance (no longer in place) and that the information provided did not support the conclusion that Fairbanks controls (also no longer in place) provide equivalent or more stringent control. EPA also commented that date certain removal needed to be considered for the nonattainment area.

Analysis

Alaska's new regulation 18 AAC 50.077(a) specified that a person may not install, reinstall, sell, lease, distribute, or convey wood-fired heating devices that lack a valid EPA certification under 40 C.F.R. 60.533 or any wood-fired outdoor hydronic heaters, except pellet fueled devices. Subsection (l) requires owners to render all noncompliant devices permanently inoperable by December 31, 2024. Subsection (m) requires all noncompliant devices to be rendered permanently inoperable when removed.

The current device inventory estimates that approximately 13,418 wood burning appliances are in the nonattainment area with 2,553 of those appliances estimated to be uncertified. Estimates also show approximately 481 coal fired residential heaters in the nonattainment area for a total of 3,034 appliances that need to be removed. Current funding for the Borough's wood stove change out program show that, including the 2018 Targeted Air Shed grant award, the total projected change outs achievable from 2019 through 2024 are 1,290. The date of 2024 provides residents adequate time to participate in the wood stove change out program in order to comply with the regulation without overwhelming the Borough program resources.

The new state regulation 18 AAC 50.077(h) requires owners to register devices upon sale or conveyance, prior to closing if being sold, when applying for a waiver, to participate in Burn Right and woodstove change out or conversion programs and prior to close out of enforcement actions. Collectively, the above mandates in the new Alaska regulations are more stringent than Puget Sound's removal requirements, which only address uncertified wood stoves, which satisfies one of EPA's comments.

Alaska's new Alert thresholds (20 $\mu g/m^3$ and 30 $\mu g/m^3$ respectively for Stage 1 and Stage 2 restrictions) established in the Episode Chapter, presented in the introduction, are significantly more stringent than Washington State thresholds established in WAC 173-433-140 (the more stringent for Pierce, Snohomish, and Yakima counties set values of 25 $\mu g/m^3$ and 30 $\mu g/m^3$)

The emission limits under C.F.R. 605.33 are more stringent (i.e., 4.5 g/hr for devices meeting 2015 standards and 2.0 g/hr for devices meeting 2020 emission standards) than the 7.5 g/hr threshold in the Oregon DEQ regulations. This means that when Alerts are called in Fairbanks at lower thresholds more restrictive requirements apply to the wood stove allowed to burn. These requirements satisfy EPA's concern about stringency of the applicable controls.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 17: Require Removal of Uncertified Solid Fuel Burning Devices Upon Sale of Property

Applicable Jurisdiction(s)

- State of Oregon

Regulation Weblink(s)

- https://www.oregonlegislature.gov/bills_laws/ors/ors468A.html
- http://www.deq.state.or.us/regulations/rules/excerpt/262-20110309-Rule.pdf

Background

The Oregon legislative body, under Senate Bill 102,[33] in 2009 extended legislation relating to solid fuel burning devices to reduce the number of uncertified wood burning devices in the state. Among other additions, they included the requirement that sellers of properties that contain uncertified solid fuel burning devices bear the responsibility of the removal and destruction of those devices unless the seller and buyer agree in writing that the responsibility was to become the buyer's. If the seller retains responsibility, the device needs to be removed from the structure prior to the closing date of sale of the structure. If the buyer is to accept responsibility, the buyer must remove and destroy the device within 30 days of closure of sale of the property. In addition, the person responsible for removal and destruction of the device must show proof of such to the Oregon Department of Environmental Quality (ODEQ).

Following enactment of this legislation, the ODEQ also adopted a series of regulations in 2011 to implement the requirements of Senate Bill 102.[34] ODEQ Regulation 340-262-0700[35] requires the same procedure for uncertified solid fuel burning devices in Oregon prior to or shortly after sale of a property. The resulting program came to be known as Oregon's Heat Smart program.[36]

The State of Alaska had regulations affecting the removal of uncertified wood burning devices during property transactions in Fairbanks that became effective June 9, 2017.[37] Those regulations required removal or replacement of non-compliant wood-fired heating devices before

[33] https://olis.leg.state.or.us/liz/2009R1/Measures/Overview/SB102
[34] http://www.oregondeq.com/regulations/rules/summary/262-20110121-Summary.htm
[35] http://www.deq.state.or.us/regulations/rules/excerpt/262-20110309-Rule.pdf
[36] http://www.oregon.gov/deq/Residential/Pages/heatsmart.aspx
[37] http://dec.alaska.gov/air/anpms/comm/docs/18AAC50.077.pdf

the sale, lease, or conveyance of property within the Nonattainment Area. The regulations were intended to improve air quality by reducing the number of older, more polluting wood-fired heating devices in the area over time. Wood-fired devices that appear on any of DEC's lists of EPA-certified and Phase 2 "White Tag" devices did not need to be removed or replaced.

EPA commented that the conclusion of Measure 17 referenced Fairbanks, but the analysis referred to AAC code. This inconsistency has been corrected.

Analysis

There were some exceptions and the ability for temporary waivers under 18 AAC 50.077 (h) which allowed temporary waivers. Those regulations have been repealed and replaced. Alaska's new regulations 18 AAC 50.077(a) specify that a person may not install, reinstall, sell, lease, distribute, or convey wood-fired heating devices that lack a valid EPA certification under 40 C.F.R. 60.533 or any wood-fired outdoor hydronic heaters, except pellet fueled devices, including those that have a qualifying "white tag" under EPA's Phase 2 voluntary partnership program. 18 AAC 50.077 (l) requires owners to render all noncompliant devices permanently inoperable by December 31, 2024. Subsection (m) requires all noncompliant devices to be rendered permanently inoperable when removed. Alaska's new permanent inoperability requirements are significantly more stringent than Oregon's removal requirements, which only address uncertified wood stoves.

Subsections (a) and (l) of 18 AAC 50.077 do not apply to the conveyance of a wood-fired heating device if the owner requests and receives a temporary waiver from the department or a local air quality program. Temporary waivers may be granted for the following considerations:

(1) financial hardship information provided by the owner or operator;

(2) technical feasibility information provided by the owner or operator; and

(3) potential impact to locations with populations sensitive to exposure to PM-2.5; locations under this paragraph include hospitals, schools, child care facilities, health clinics, long-term care facilities, assisted living homes, and senior centers;

Alaska's new removal requirements prior to sale are considerably more stringent than Oregon's which only apply to uncertified solid fuel devices. Oregon allows the purchaser up to 30-days to remove uncertified devices after the transaction is completed; Alaska DEC does not. DEC allows a temporary waiver that increases the time for removal for a limited category of transactions. The limited increase in emissions associated with the temporary waivers is more than offset by the higher stringency of devices impacted by Alaska's new regulations.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 18: No Visible Emissions during Curtailment Periods

Applicable Jurisdiction(s)

- Maricopa County, Arizona

Regulation Weblink(s)

- https://www.maricopa.gov/DocumentCenter/View/5332

Background

A Maricopa County ordinance[38] allows wood stoves certified as the sole source of heat in a residential dwelling to continue operating during curtailment periods provided that these stoves emit no visible emissions, i.e. 0% opacity. Most other jurisdictions with wood burning regulations limit visible emissions from wood stoves permitted to operate during curtailment periods to 20% opacity.

Communication with staff members from Maricopa County's Air Quality Department indicated that no staff report was prepared when the "no visible emission" regulation was first adopted in 1994.[39] Communication with a staff member from Montana's Department of Environmental Quality indicated that Montana, where ambient temperatures during the winter nonattainment season can drop to low levels that approach those in Fairbanks, maintains a restriction that allows visibility up to 20%.[40] Historical EPA literature states that "It can be difficult to distinguish pollutant-containing mists from innocuous water droplets that are generated from steam condensation,"[41] and advises inspectors that "if the temperature is low...consider the possibility of a steam plume that does not evaporate easily."[42] Academic literature summarizing EPA's Method 9 states:

[38] Ordinance P-26, Section 3.C.1 of Maricopa County Ordinance P-26: Residential Woodburning Restriction, available at https://www.maricopa.gov/DocumentCenter/View/5332; accessed October 12, 2017.
[39] Personal communication with Johann Kuspert, Maricopa County Air Quality Department, September 28, 2017.
[40] Personal communication with Benjamin Schmidt, Montana Department of Environmental Quality, October 6, 2017.
[41] Rose, Thomas H, Visible Emission Evaluation Procedures Course Student Manual APT/ Course 325 Final Review Draft, 1995, available at https://www3.epa.gov/ttnemc01/methods/VECourse.pdf; accessed October 12, 2017.
[42] Eastern Technical Associates and Entrophy Environmentalist, Inc., Visible Emissions Field Manual EPA Methods 9 and 22, EPA 340/1-92-004, 1993, available at https://www3.epa.gov/ttnemc01/methods/VEFieldManual.pdf; accessed 10-12-2017

In cold weather, steam is often a part of the emission. In order to make an accurate reading, opacity must be read after the steam has dissipated. This change is readily visible as the apparent opacity will drop significantly but stay constant after that.[43]

Analysis

Two additional considerations in Fairbanks are that (1) daylight is limited during winter months to no more than 5 hours/day in December, January and February, the period when elevated $PM_{2.5}$ concentrations are most likely to occur, and (2) oil- and gas-fired heating devices generate condensing moisture plumes but are not required to cease operation during curtailment periods. These factors have led the Borough in the past to develop a checklist of considerations to differentiate between wood/coal stoves and oil/gas furnaces. These considerations include:

- Odor – smelling the smoke is often the first and best indication of wood or coal burning;
- Multiple Stacks – frequently an indication of a secondary heating device besides a furnace;
- Location of Stack – stacks located over a garage connected to the house is typically for an oil/gas furnace; stacks over separated garages and sheds/shops is an indication of a SFBD; stacks located above a common area, such as a living room, are an indication of a SFBD;
- Black Soot around Stack – black residue over snow & around stacks indicates solid fuel burning;
- Dark or Colored Smoke – darker colored smoke can be an indication of low temperature wood burning and coal burning;
- Cycling Smoke Plumes – an abrupt change in the plume is an indication of an oil/gas furnace;
- Piles or Stacked Cut Wood – are a clear indication of a wood burning device;
- Exterior chutes – are an indication of a coal burning device;
- Property Database Check – the Borough's database can provide information on original installations, Deed Restrictions, etc.

This checklist allowed Borough field personnel to efficiently determine whether plumes are coming from homes violating Stage 1 or Stage 2 Alerts. Borough personnel were able to survey 40 homes per day during a 5-hour shift (8 homes per hour) to determine compliance with Stage 1 or Stage 2 Alerts. Compliance was determined by observing a SFBD in operation, without the need for an opacity observation. Opacity observations during stage restrictions would add the problem of differentiating steam from particles, compounding the previously identified difficulties of limited daylight and differentiating from oil and gas fired heating devices. A reduction in the limit to zero visibility would require any field staff to monitor each home for a minimum of 20 minutes to identify if a continuous plume with decreasing opacity represents a wood-fired device during startup, and to record the minimum number of observations required by EPA Method 9. Enforcing a zero opacity standard during curtailment would limit the number

[43] University of Nebraska-Lincoln, Safe Operating Procedure: Opacity of Emissions from Combustion Sources and Operating Log Record, 2017, available at https://ehs.unl.edu/sop/s-opacity_emissions.pdf; accessed October 12, 2017.

of homes observed per hour to 2 or less (20+ minutes opacity reading time plus travel time, identification of stacks, etc.). The reduction in the number of homes observed would significantly reduce the identification of Alert violations and benefits of the enforcement program. As a result, implementation of this measure would result in increased emissions during curtailment periods as fewer homes would be inspected for compliance. Fairbanks is no longer enforcing this measure because of the passage of the Home Heating Reclamation Act. While the state is now enforcing this measure under the Episode Chapter of the $PM_{2.5}$ Serious SIP, the same issues noted above apply as the implementation of the measure would lead to a reduction in the number of homes inspected for compliance.

Conclusion

This measure is technologically infeasible because a more stringent visibility standard would reduce the number of homes inspected, reduce the number of violations identified and allow for an increase in wood burning emissions. Therefore, this measure is not eligible for consideration as BACM.

Measure 19: Require Registration of Devices to Qualify for Exemption from Curtailments

Implementing Jurisdiction(s)

- Missoula City-County MT, San Joaquin Valley APCD

Regulation Weblink(s)

- https://www.missoulacounty.us/home/showdocument?id=8452
- https://www.valleyair.org/rules/currntrules/r4901.pdf

Background

Missoula City-County requires woodstoves to have a valid alert permit in order to continue operating during a Stage 1 Alert (Section 9.205.1). Wood heating devices eligible to receive alert permits include pellet stoves; woodstoves meeting a 6.0 gm/hr $PM_{2.5}$ emission limit that were installed prior to June 30, 1988 and continuously enrolled in the alert permit program since installation; and woodstoves meeting a 4.1 gm/hr emission limit that were installed and continuously enrolled in the alert permit program since October 1, 1994 (Sections 9.205.2 through 9.205.4). Alert permits are valid for five years, except those issued to woodstoves with catalytic converters, which are valid for two years (Section 9.205.7). Permit renewal requires submittal of an application and inspection by the agency or submittal of documentation of adequate maintenance of non-durable parts sufficient to meet applicable emission limitations (Section 9.205.5).

Missoula City-County also allows wood heating devices with valid sole source permits to be operated during Stage 1 Alerts (Section 9.206.1). Wood heating devices eligible to receive new sole source permits are limited to pellet stoves. Devices eligible to receive sole source permit

renewals are limited to (1) pellet stoves and (2) woodstoves continuously enrolled in the sole source permit program since July 1, 1985 (Sections 9.206.2 and 9.206.4). Similar exemptions to curtailment requirements are also allowed for wood heating devices with special need permits and with temporary sole source permits (Sections 9.207 and 9.208). All wood heating devices are eligible to receive special need and temporary sole source permits. To qualify, the owners of such devices must qualify for energy assistance under the federal Low-Income Energy Assistance Program – in the case of special need permits – or have a temporarily inoperable primary heating system and satisfy other requirements in the case of temporary sole source permits. Applications documenting compliance with the requirements of either program must be submitted to the agency in order to qualify for the applicable permit (Section 9.209).

San Joaquin Valley APCD prohibits wood-fired heating devices from being operated during a Level One Episodic Wood Burning Curtailment except for USEPA Phase II certified devices and pellet stoves, provided that these are registered with the District (Rule 4901 Section 5.6.1). In areas where natural gas service is not available, registration is not required for a device to be operated during a Burning Curtailment.

Registrations are valid for a period of up to three years. Registration may be renewed by submitting a Registration Renewal application with verification that the wood burning device has been inspected by a Registered Professional to verify that it is maintained pursuant to manufacturer specifications (Section 5.8).

Fairbanks allowed Borough-listed devices to continue operating during a Stage 1 air alert if such devices had approved Stage 1 waivers. Borough-listed devices included USEPA Phase II certified wood stoves, USEPA certified hydronic heaters, masonry heaters, cook stoves, or other devices emitting 2.5 gm/hr or less as documented by accepted testing. Stage 1 waivers did not have expiration dates. These regulations were removed from Borough Code following voter approval of the Home Heating Reclamation Act.

EPA commented that the Fairbanks requirements lacked the regular renewal and inspection opportunities to verify proper device operation.

Analysis

All three agencies require the registration of permitting of wood heating devices in order to be operated during burning curtailment periods. As discussed in the analysis of Measures 15 and 16, Alaska's new regulation 18 AAC 50.077(h)(3) requires all wood-fired heating devices to be registered with DEC prior to issuance of any waivers described in the State Air Quality Control plan. The Episode Chapter of that document details the requirement for the issuance of a waiver and the related application, renewal and inspection requirements for all solid-fuel heating devices. All devices require an initial inspection/maintenance verification by a certified chimney sweep. All devices with an emissions rating of >7.5 g/hr are only eligible for 2 annual waivers, lower emitting devices are eligible for longer waiver periods (2, 3 and 5-years). Only devices with an emission rating of <2.0 g/hr are allowed 5-year waivers. These requirements are consistent with those specified in both Missoula City- County and San Joaquin Valley and address EPA's comments.

While Fairbanks currently has natural gas service, it is capacity constrained and will not be in a position to expand service to new customers until 2020 (i.e., after the designated attainment year.[44] Thus, the San Joaquin Valley APCD regulation, which exempts unregistered wood heating devices from curtailment requirements in areas with no natural gas service, is significantly less stringent than the Alaska regulations.

Conclusion

The adoption of the referenced Episode Chapter requirements and state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 20: Require Renewals with Inspection Requirements

Implementing Jurisdiction(s)

- San Joaquin Valley APCD

Regulation Weblink(s)

- https://www.valleyair.org/rules/currntrules/r4901.pdf

Background

San Joaquin Valley APCD prohibits wood-fired heating devices from being operated during a Level One Episodic Wood Burning Curtailment except for USEPA Phase II certified devices and pellet stoves, provided that these are registered with the District (Rule 4901 Section 5.6.1). Qualifying wood heaters are eligible for registration by submitting a completed application and supplemental documentation to the District including certification by a District Registered Wood Burning Heater Professional that the device is either a Phase II certified device or a pellet stove (Section 5.7.3.1). If the device for which registration is being sought is more than one year old at the time of initial registration, the application for registration much include proof of inspection by a Registered Professional (Section 5.7.3.1.3). In areas where natural gas service is not available, registration is not required for a device to be operated during a Burning Curtailment.

Registrations are valid for a period of up to three years. Registration may be renewed by submitting a Registration Renewal application with verification that the wood burning device has been inspected by a Registered Professional to verity that it is maintained pursuant to manufacturer specifications (Section 5.8).

Fairbanks allowed Borough-listed devices to continue operating during a Stage 1 air alert if such devices had approved Stage 1 waivers. Borough-listed devices included USEPA Phase II certified wood stoves, USEPA certified hydronic heaters, masonry heaters, cook stoves, or other

[44] Appendix A of the Financing Agreement between AIDEA and IGU, December 13, 2017

devices emitting 2.5 gm/hr or less as documented by accepted testing. Stage 1 waivers did not have expiration dates. These regulations were removed after passage of the Home Heating Reclamation Act.

EPA commented that the Fairbanks requirements lacked the regular renewal and inspection opportunities to verify proper device operation.

Analysis

All three agencies require the registration or permitting of wood heating devices in order to be operated during burning curtailment periods. As discussed in the analysis of Measures 15 and 16, Alaska's new regulation 18 AAC 50.077(h) requires all wood fired-heating devices to be registered when applying for any waivers described in the State Air Quality Control plan. The Episode Chapter of that document details the requirement for the issuance of a waiver and the related renewal and inspection requirements separately for related application, renewal and inspection requirements for all solid-fuel heating devices. All devices require an initial inspection/maintenance verification by either the owner or a professional installer. All devices with an emissions rating of >7.5 g/hr are only eligible for 2 annual NOASH waivers. Devices with an emission rating of >7.5 g/hr are not allowed a Stage 1 waiver. Lower emitting devices are eligible for longer NOASH or Stage 1 waiver periods (up to 2, 3 and 4-years). Only devices with an emission rating of <2.0 g/hr and have an ESP are allowed up to a 5-year waiver provided all the criteria is met. These requirements are consistent with those specified in San Joaquin Valley and address EPA's comments.

While Fairbanks currently has natural gas service, it is capacity constrained and will not be in a position to expand service to new customers until 2020 (i.e., after the designated attainment year).[45] Thus, the San Joaquin Valley APCD regulation, which exempts unregistered wood heating devices from curtailment requirements in areas with no natural gas service, is significantly less stringent than the Alaska regulations. Thus, implementation of this measure would have no impact in Fairbanks as nearly all wood-fired heating devices would be exempt from registration and registration renewal.

Conclusion

The adoption of the referenced Episode Chapter requirements and state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 21: Optional Device Registration for Curtailment Exemptions

Implementing Jurisdiction(s)

- San Joaquin Valley APCD; Maricopa County

[45] AIDEA IGU Financing Agreement op. cit., Appendix A

Regulation Weblink(s)

- https://www.valleyair.org/rules/currntrules/r4901.pdf
- http://www.maricopa.gov/DocumentCenter/View/5332

Background

San Joaquin Valley APCD prohibits wood-fired heating devices from being operated during a Level One Episodic Wood Burning Curtailment except for USEPA Phase II certified devices and pellet stoves, provided that these are registered with the District (Rule 4901 Section 5.6.1). Registration is not required for operation of a USEPA Phase II certified device or pellet stove during non-curtailment periods, nor is registration required for operation of non-District-listed devices during non-curtailment periods. Thus, owners of District-listed devices have the option of registering their devices with the District, and are only required to register if the owners want to operate these devices during curtailment periods.

Maricopa County does not require the registration of approved wood-heating devices in order for these to be used during curtailment periods. (Section P-26.3.C.2) This regulation requires only that such devices operate with no visible emissions during curtailment periods except during 20 minute startup and refueling periods.

As noted in the analysis of Measure 19, Fairbanks required the registration of wood heating devices that qualify as Borough-listed appliances if the owners of such devices desire to operate them during Stage 1 air alert periods. These regulations were removed after passage of the Home Heating Reclamation Act.

EPA commented that the Fairbanks requirements lacked the regular renewal and inspection opportunities to verify proper device operation.

Analysis

This measure references the same regulations addressed in the Measure 19, therefore the same analysis and conclusions apply; they are restated below.

All three agencies require the registration of permitting of wood heating devices in order to be operated during burning curtailment periods. Alaska's new regulation 18 AAC 50.077(h)(3) requires all wood fired-heating devices to be registered with DEC prior to issuance of any waivers described in the State Air Quality Control plan. The Episode Chapter of that document details the requirement for the issuance of a waiver and the related renewal and inspection requirements separately for related application, renewal and inspection requirements for all solid-fuel heating devices. All devices require an initial inspection/maintenance verification by either the owner or a professional installer. All devices with an emissions rating of >7.5 g/hr are only eligible for 2 annual NOASH waivers. Devices with an emission rating of >7.5 g/hr are not allowed a Stage 1 waiver. Lower emitting devices are eligible for longer NOASH or Stage 1 waiver periods (up to 2, 3 and 4-years). Only devices with an emission rating of <2.0 g/hr and have an ESP are allowed up to a 5-year waiver provided all the criteria is met. These

requirements are consistent with those specified in both Missoula City- County and San Joaquin Valley and address EPA's comments.

While Fairbanks currently has natural gas service, it is capacity constrained and will not be in a position to expand service to new customers until 2020 (i.e., after the designated attainment year.[46] Thus, the San Joaquin Valley APCD regulation, which exempts unregistered wood heating devices from curtailment requirements in areas with no natural gas service, is significantly less stringent than the Alaska regulations.

Conclusion

The adoption of the referenced Episode Chapter requirements and state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 22: Require Registration of All Devices

Implementing Jurisdiction(s)

- Missoula City-County MT

Regulation Weblink(s)

- https://www.missoulacounty.us/home/showdocument?id=8452

Background

Missoula City-County requires Installation permits for the installation and use of any new solid fuel burning device in any structure within the Air Stagnation Zone effective July 1, 1986 (Section 9.202). This regulation limits the eligibility of Installation permits to pellet stoves certified to a $PM_{2.5}$ emission limit of 1.0 gm/hr (Section 9.203).

Fairbanks and the State had prohibited the installation of solid fuel burning devices (SFBD) that are not Borough or State-listed. Borough and State-listed devices included USEPA Phase II SFBDs certified to a $PM_{2.5}$ emission limit of 2.5 gm/hr, masonry heaters, cook stoves, and other SFBDs certified to a $PM_{2.5}$ emission limit of 2.5 gm/hr (Section 21.28.020). During Stage 1 Alerts, only Borough-listed devices with Stage 1 waivers issued by the Borough and devices in households with no other adequate source of heat determinations were allowed to continue in operation during burning curtailment periods. These regulations were removed after passage of the Home Heating Reclamation Act. However the State regulations remained in place and the State allowed NOASH waivers, and honored Borough issued waivers, during the winter of 2018-2019, the State did not issue any new Stage 1 waivers.

Analysis

[46] Appendix A of the Financing Agreement between AIDEA and IGU, December 13, 2017

A review of Missoula's regulations found that the Air Stagnation Zone extends roughly 4 miles outside of Missoula City, which is only a small portion of the nonattainment area boundary for the County. As discussed in Measure 20, Alaska's new regulation 18 AAC 50.077(h) requires all wood fired-heating devices to be registered when applying for any waivers described in the State Air Quality Control plan. While 18 AAC 50.077 (c),(d),(n) allow the installation of wood fired heating devices meeting an emission limit of 2.0 gm/hr, the Missoula regulation provides no restriction on the emission rate of wood fired heating devices installed outside of the Air Stagnation Zone. The Alaska installation restriction at a higher emission rate covers the entire nonattainment area, while the more restrictive Missoula installation restriction applies to only a small portion of the nonattainment area.

Another consideration is that Measure 22 only applies to new installations and relies on device turnover to be effective. As noted above, the emission rate specified in Alaska's new rule is less stringent than Measure 22, however, 18 AAC 50.077 requires owners to render noncompliant devices permanently inoperable, as well as requires the removal and replacement of noncomplying devices during real estate transactions. Furthermore, 18 AAC 50.077, as discussed in the analysis section under Measure 8, has added additional requirements based on the certification test results that will only allow devices to be listed that have demonstrated more consistent performance and likely have more realistic lower emissions. 18 AAC 50.077 also requires a number of devices, both uncertified and certified to be removed by December 31, 2024. The permanent inoperability requirement in combination with the 2.0 g/hr PM emission limit will result in greater emission reductions in the near term and is therefore more stringent.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 23: Require Exempt Households to Display a Decal Visible from a Point of Public Access

Implementing Jurisdiction(s)

- Ada County, Idaho

Regulation Weblink(s)

- http://www.sterlingcodifiers.com/codebook/index.php?book_id=447

Background

The Ada County Development Services Department exempts NOASH households and Department-listed low emission wood heating devices from having to cease operation during

curtailment periods (Section 5-10-8.A). One of the requirements for a valid exemption is that each affected household display an exemption decal visible from a point of public access.

Previously, the Borough prepared lists of residences registered as NOASH households and those heated with Borough-approved appliances. These lists were used by Borough enforcement staff in the field to identify such residences during Stage 1 Alert periods as exempt from wood burning curtailment requirements. The authority to assemble these lists disappeared with the passage of the Home Heating Reclamation Act

EPA commented that decals could be reflective and would be seen by vehicle headlights, that decals could be used by neighbors to determine who is or is not in compliance and they might be helpful as citizen compliance assistance efforts could supplement the Borough enforcement program.

Analysis

The Ada County measure is intended to facilitate field compliance inspections by highlighting non-exempt residences with visible smoke plumes for enforcement actions. Because of the high prevalence of oil heaters in all Borough residences (79.0%), determination of compliance with curtailment requirements requires a minimum of 20-minute opacity observations – except in the case of NOASH residences - to ascertain oil versus wood fuel sources of visible emissions. Determination of compliance at NOASH residences, which constitute only 2.2% of residences in the nonattainment area, can be ascertained as quickly by examination of a list of NOASH addresses as by observation of a visible decal. Moreover, the Borough prepared lists of residences have been made available to state enforcement staff and are being used to identify registered NOASH residences using tablets with maps noting their locations. The adoption of decals will add no benefit to current enforcement efforts, thus EPA's comments are not relevant.

Conclusion

The adoption of a visible decal regulation will not provide an emissions reduction benefit during Stage 1 Alerts and, thus, is not technologically feasible. Therefore, this measure is not available for consideration as BACM.

Measure 24: Require Permanent Installed Alternative Heating Method in Rental Units

Implementing Jurisdiction(s)

- Bay Area AQMD; Klamath County; City of Aurora CO

Regulation Weblink(s)

- http://www.baaqmd.gov/~/media/files/planning-and-research/rules-and-regs/reg-06/rg0603.pdf?la=en

- http://www.co.klamath.or.us/EH/Air%20Quality%20&%20Burning/Klamath%20County%20Clean%20Air%20Ordinance.htm
- https://library.municode.com/co/aurora/codes/building_and_zoning?nodeId=BUZOCO_CH146ZO_ART12SURESPUSAC_DIV1GEUS_S146-1204BURE

Background

The Bay Area AQMD requires that all real property offered for lease or rent must have a permanently-installed form of heat that does not burn solid fuel (Section 6-3-305). This requirement becomes effective on November 1, 2018, and is not applicable to properties located in areas not served by natural gas infrastructure.

Klamath County prohibits a solid fuel-fired appliance from being the sole source of heat in any non-owner (tenant) occupied dwelling unit within the county (Section 406.100.3.d).

The City of Aurora, Colorado, also prohibits a solid fuel-fired heating device from being the sole source of heat in any non-owner-occupied dwelling unit (Section 146-1204.C).

Neither Fairbanks nor the state had wood heating device regulations that are specific to rental units, except the State contingency measure regarding conveyance of a non-certified device during a real estate transaction, and opacity requirements. These requirements were in effect regardless of the device used in a residence or rental until. However, neither entity had adopted any regulations that require the installation of alternative heating systems in either new construction or existing structures.

Analysis

The Bay Area AQMD measure exempts areas not served by natural gas infrastructure from the requirement for rental units to have alternative heating systems. While Fairbanks currently has natural gas service, it is capacity constrained and will not be in a position to expand service to new customers until 2020 (i.e., after the designated attainment year).[47] Therefore, this measure would not reduce emissions during curtailment periods if adopted by the state.

Both the Klamath County and City of Aurora measures would, if adopted by Alaska, require the retrofitting of applicable rental units with alternative heating systems and, thus, make such dwellings ineligible for no-other-adequate-source-of-heat (NOASH) determinations by the Borough.

As noted in the introduction, Alaska added a new subsection 50.077(j): Wood-fired heating devices may not be the primary or only heating source in:

- New construction, except a “dry cabin” on a 2-acre parcel
- For rental units, unless a rental unit had the wood heating device prior to the effective date of the regulations and qualified for a NOASH

[47] AIDEA IGU Financing Agreement op. cit., Appendix A

This new requirement directly addresses the Klamath County and City of Aurora measures and eliminates the emission benefit of adopting them

Conclusion

The adoption of the referenced state regulation is sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 25: Require Detailed Application or Inspection to Verify Need for No Other Adequate Source of Heat (NOASH) Permit

Implementing Jurisdiction(s)

- Puget Sound Clean Air Agency (PSCAA)

Regulation Weblink(s)

- http://www.pscleanair.org/219/PSCAA-Regulations

Background

The Puget Sound Clean Air Agency (PSCAA) exempts households with no other adequate source of heat (NOASH) from curtailment requirements if the residences or commercial buildings were constructed prior to July 1, 1992 and not substantially remodeled after that date, and the households have been granted exemptions by the agency (Section 13.05.d.1.a). PSCAA grants NOASH exemption only after receipt and review of a detailed application form.[48]

Fairbanks previously exempted NOASH households from having to cease burning wood during Stage 1 Alerts provided that such households have registered with the Borough. The Borough granted NOASH determinations only after receipt and review of detailed application form that must be notarized before submittal[49]. Regulations mandating these requirements were removed after passage of the Home Heating Reclamation Act.

As noted in Measures 19 and 21, EPA commented that the Fairbanks requirements lacked the regular renewal and inspection opportunities to verify proper device operation.

Analysis

[48] Personal communication between Amy Warren, PSCAA, and Meena Rezaei, Trinity Consultants, on December 15, 2017. Application available for download at: http://www.pscleanair.org/DocumentCenter/View/163; accessed on January 14, 2018.
[49] Application was for download at: http://fnsb.us/transportation/Pages/Change-Out-Program.aspx; accessed on January 14, 2018

The Episode Chapter of the $PM_{2.5}$ Serious SIP noted in the introduction details Alaska's exception and waiver requirements including:

- Length of waivers based on age and emission rate of the device
- Annual renewals on oldest and highest emission rated devices
- 3rd party inspection of device to verify proper installation required
- 3rd party inspection of maintenance (chimney sweep) required
- Device registration required
- Documentation of dry wood required

Exceptions/Waiver levels are detailed in Tables for Stage 1 and Stage 2 Alerts separately for non-catalyst equipped and pellet/catalyst equipped devices. The structure is intended to provide incentives to upgrade existing devices while at the same time acknowledging the number of devices already changed out as part of the wood stove change out program. A detailed application and verification documentation will be required prior to issuance of any exception or waiver.

These requirements are consistent with PSCAA NOASH curtailment and application requirements and address EPA comments about renewal and inspection opportunities to verify proper device operation.

Conclusion

The adoption of the referenced Episode Chapter requirements are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 26: Require Inspection of Device and Installation

Implementing Jurisdiction(s)

- San Joaquin Valley APCD

Regulation Weblink(s)

- https://www.valleyair.org/rules/currntrules/r4901.pdf

Background

San Joaquin Valley APCD requires that applications for wood burning device registration contain certifications by District Registered Wood Burning Heater Professionals verifying that the wood burning heaters meet device eligibility requirements (Section 4901.5.7.3.1.2). This regulation also requires applications for registration renewal to include verifications that the wood burning heaters have been inspected by District Registered Wood Burning Heater Professionals and found to be maintained pursuant to manufacturer specifications (Section 4901.5.8.2.1).

Fairbanks required installations of solid fuel burning appliances in new construction and replacement appliances in subsidized change-outs be performed by Borough-listed vendor/installers using Borough-listed appliances. Regulations mandating these requirements were removed after passage of the Home Heating Reclamation Act.

Analysis

The San Joaquin Valley measure requires that devices applying for registration be inspected by District-registered professional to confirm that the devices are District-listed as low emission units. As noted in Measure 4, recognizing the need for professional installation of wood-fired heating devices and wood-fired retrofit control devices and confirmation of those installations, the state has implemented a new regulation subsection 18 AAC 50.077(i), which directly addresses these requirements. As noted in Measure 5, 18 AAC 50.077(i) also requires the certification of installers by the National Fireplace Institute or Masonry Heaters Association as appropriate. In addition, the Episode Chapter of the $PM_{2.5}$ Serious SIP contains requirements that all NOASH devices must be inspected by certified installers.

Collectively, the new Alaska regulations and Episode Chapter requirements more than satisfy the San Joaquin Valley certification and inspection requirements to ensure that wood burning wood burning heaters meet device eligibility requirements.

Conclusion

The adoption of the referenced Episode Chapter requirements and state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 27: Require Annual Renewal of Waiver

Implementing Jurisdiction(s)

- Maricopa County

Regulation Weblink(s)

- http://www.maricopa.gov/DocumentCenter/View/5332

Background

Maricopa County AZ requires that residential sole source of heat (NOASH) permits be renewed annually (Ordinance P-26, Section 4.A). This regulation is intended to annually confirm compliance of the permitted household with NOASH requirements and minimize the number of permits issued to non-compliant households. Section 4.A also prohibits the initial issuance of a NOASH permit after December 31, 1995, and allows for annual permit renewal if the initial

permit was issued before December 31, 1995 and the household and device continue to meet permit requirements.

Fairbanks required that NOASH households apply and be approved in order to continue burning during curtailment periods. NOASH designations were valid for one year and required renewal to remain valid.[50] The Borough regulations were removed with the passage of the Home Heating Reclamation Act.

Analysis

The exception and renewal requirements for NOASH waivers are specified in the Episode Chapter of the $PM_{2.5}$ Serious SIP. As noted in the Measure 26 analysis, all registration require verification by certified installers. Renewal requirements vary by age, control technology and emission rating. Higher emitting devices older than 10 years are limited to 2 annual renewals. Thus, pre-2010 higher emitting devices are only allowed 2 renewals. Longer renewal periods are allowed for lower emitting devices. Maricopa does not limit the number of renewals for devices installed prior to December 31, 1995. Also, as noted in Measure's 16 and 17 Alaska requires the that a person may not install, reinstall, sell, lease, distribute, or convey wood-fired heating devices that lack a valid EPA certification under 40 C.F.R. 60.533 or any wood-fired outdoor hydronic heaters, except pellet fueled devices. This requirement ensures rapid turnover of the existing stock of older, higher emitting wood-burning devices over the next 5 years, whereas the Maricopa regulation relies on a much slower turnover of pre 1996 wood-burning devices, while providing no incentive to retire post 1995 wood burning devices. Thus, the older Maricopa NOASH devices can continue to operate into the future, whereas in Alaska those devices (and many more) are required to be rendered permanently inoperable by December 31, 2024.

Collectively, the new Alaska regulations provide greater emission reductions than would be produced by the adoption of Measure 27.

Conclusion

The adoption of the referenced Episode Chapter requirements and state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 28: Set Income Threshold [for Curtailment Exemption]

Implementing Jurisdiction(s)

- Missoula MT; Maricopa County AZ

Regulation Weblink(s)

[50] Personal communication between Nicholas Czarnecki, FNSB Air Quality Division, and Bob Dulla, Trinity Consultants, on December 19, 2017.

- https://www.missoulacounty.us/home/showdocument?id=8452
- http://www.maricopa.gov/DocumentCenter/View/5332

Background

The Missoula City-County Air Pollution Control Program exempts households qualifying for energy assistance from burning curtailment requirements (Section 9.207). Maricopa County grants temporary exemptions from curtailment requirements to households qualifying for energy assistance (Section 4.B).

Fairbanks did not exempt households from curtailment requirements solely on the basis of income, but did allow the granting of sole-source-of-heat exemptions to households in which "economic hardships require the applicant's use of a solid fuel burning appliance" provided that the appliance is Borough-listed, in addition to other requirements. The Borough regulations were removed with the passage of the Home Heating Reclamation Act.

Analysis

The Missoula City-County measure allows low income households to continue burning during curtailment periods. While Alaska will also allow low income households to continue burning during curtailment periods (per the Episode Chapter of the $PM_{2.5}$ Serious SIP), NOASH exceptions/waivers are not exempt from the restrictions noted above in Measure 27. This means the pool of NOASH waivers will become increasingly cleaner (i.e., lower emitting) over the next 5 years. At this point, Alaska has established the economic hardship thresholds for NOASH waivers, consistent with the previous Borough thresholds, economic hardships must provide documentation of enrollment in one of several assistance programs; according to the Episode Chapter they are defined in the NOASH applications.

Overall, the removal or permanent inoperability requirements of 18 AAC 70.077(a) & (l) will result in greater emission reductions in the near term than any differences in the definition of economic hardship and is therefore more stringent.

Conclusion

The adoption of the referenced Episode Chapter requirements and state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 29: Allow Only NOASH Households to Burn During Curtailment Periods

Implementing Jurisdiction(s)

- Utah Department of Environmental Quality

Regulation Weblink(s)

- https://rules.utah.gov/publicat/code/r307/r307-302.htm

Background

The Utah Department of Environmental Quality exempts only households with no other adequate source of heat (NOASH) from the requirement to cease operation of wood heating devices during curtailment periods in $PM_{2.5}$ nonattainment areas in the state (Section R307-302-3.4). Fairbanks exempted households with NOASH waivers, wood burning appliances with Stage 1 waivers, and wood burning appliances in households affected by power failures from similar curtailment requirements during Stage 1 Alerts. The Borough regulations were removed following the approval of the Home Heating Reclamation Act, however the State regulations remain in place. The State waiver program has mirrored the Borough program.

Analysis

Utah calls burn bans when concentrations are forecast to reach or exceed 25 $\mu g/m^3$. Alaska's Episode Chapter of the $PM_{2.5}$ Serious SIP will call Stage 1 Alerts when concentrations are forecast to exceed 20 $\mu g/m^3$. Emission reductions from Alaska's more stringent curtailment thresholds far exceed those that would be produced by adoption Measure 29 for the Fairbanks $PM_{2.5}$ nonattainment area.

Conclusion

The adoption of the referenced Episode Chapter requirements are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 30: Distribution of Curtailment Information at Time of Sale of Wood-Burning Device

Applicable Jurisdiction(s)

- Bay Area Air Quality Management District (SF Bay Area, CA)

Regulation Weblink(s)

- http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/Particulate%20Matter/rg0603.ashx

Background

In July 2008, the Board for the Bay Area Air Quality Management District (BAAQMD) adopted amendments to their regulation of wood-burning devices (Regulation 6, Rule 3). One amendment required that "any person offering for sale, selling or providing solid fuel or wood intended for use in a wood-burning device within District boundaries shall…attach a label to each package of

solid fuel or wood sold that states the following: 'Use of this and other solid fuels may be restricted at times by law. Please check [Toll-Free Number] or [Web Address] before burning.'"

The presumed intent of this regulation is to reduce $PM_{2.5}$ emissions from wood-burning devices either through reduced sale of the devices or through reduced use of the devices during periods of curtailment.

EPA commented for this and other measures that a finding of insignificant and difficult to quantify emission reductions (i.e., de minimus) is "not a valid rationale for not considering or selecting a control measure or technology".

Analysis

As noted in the analysis of Measure 13, 18 AAC 50.077 (k)(2) requires curtailment information and proper operating instructions to be conveyed at the time of sale of new wood-burning devices by the device vendor or dealer. While this requirement has not been extended to the sale of wood, the Bay Area has not extended this requirement to the sale of wood burning devices. As discussed in Measures 15, 16 and 17 Alaska's new regulations require all noncompliant devices must be rendered permanently inoperable by December 31, 2024 and removed or replaced prior to property conveyance. These requirements will significantly expand the number of homes receiving curtailment information and directly address EPA's comment. The result is that the adoption of this measure will provide no emissions benefit.

Conclusion

The adoption of the referenced state regulations are more than sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 31: Require Sale of Only Dry Wood during Late Summer to the End of Winter

Implementing Jurisdiction(s)

- South Coast Air Quality Management District

Regulation Weblink(s)

- https://www.arb.ca.gov/drdb/sc/curhtml/R445.PDF

Background

SCAQMD's Rule 445 limits the sale of commercial firewood to seasoned only firewood from July 1 through the end of February the following year. Seasoned firewood is defined to have a moisture content of 20 percent or less by weight as determined by approved hand held moisture meters or an alternate method defined by the California Air Resources Board. Commercial wood

sellers are free to sell both seasoned and non-seasoned firewood during the remaining months of the year. The goal is to restrict the supply of unseasoned wood available for use during winter months.

Fairbanks North Star Borough Code[51] and Alaska regulation did not allow burning of firewood with a moisture content exceeding 20%. The Code was modified to remove this requirement after voter approval of the Home Heating Reclamation Act.

Alaska regulations[52] require mandatory registration of commercial wood sellers, the use of uniquely numbered three-part moisture disclosure forms, which document the date the wood was cut and findings of moisture measurements of three pieces of wood for each cord sold. The wood seller is required to sign the form, date when it was delivered and obtain signature of the customer purchasing the wood. The wood seller is also required to provide the customer with a copy of the signed disclosure form and submit to the state the department's copy of the completed disclosure form.

EPA commented that while the "Borough has SIP approved dry wood requirements that prohibit the burning of wet wood and moisture disclosure requirements by sellers, we believe that a measure limiting the sale of wet wood during the winter months should be further analyzed for BACM (and MSM) consideration."

Analysis

Alaska's 18 AAC 50.076 has been modified to include new subsections that effective October 1, 2021, ensure that all the wood being sold or provided has a moisture content of less than 20%, but with one exception for eight foot or longer round logs. This exception requires the wood seller to ensure the buyer has the ability to store the wood for the next season and will not use the wet wood for the season in which it is sold. Subsections (d)(e) & (g) require commercial wood sellers to register with the ADEC; (j) includes requirements to ensure that wood with a less than 20% moisture content is being sold after the effective date, along with the exception. 18 AAC 50.076(l) would limit non-commercial sellers to selling dry wood. Dry wood is defined as either:

- properly seasoned, split and stored covered for at least 9 months, unless confirmed dry;
- mechanically dried, where the drying process has been inspected and approved by the department to ensure consistency and reliability; or
- harvested from an inspected fire killed source that has been split, stacked, stored and confirmed dry prior to freezing;

Wood sellers are required to test, using a commercially available moisture test meter that the department has approved for accuracy, measure moisture content periodically to verify and

51 http://www.codepublishing.com/AK/FairbanksNorthStarBorough/#!/FNSBC21/FNSBC2128.html#21.28

52 http://burnwise.alaska.gov/requirements.htm

ensure stock is dry prior to selling. They are also required to document the measured moisture content, and keep a record of the measurements over the seasoning period and sign an affidavit form that the department provides attesting the wood is dry prior to sale.

The new rules recognize that commercial wood sellers will need time to build up the necessary supply of dry wood required to satisfy overall firewood demand. In the intervening period, wood sellers are required to follow the regulations outlined in the background discussion.

Lacking infrastructure, such as kiln capacity sufficient to dry a season's worth of wood, the only technically feasible method of drying commercially available cordwood to less than 20% moisture content is to air dry the wood. A study of the time required to dry wood in Fairbanks[1] found that a minimum of six summer months with covered storage is required to dry wood from spring cutting to a moisture level below 20%. However, ADEC regulation 18 AAC 50.076 (k) has set the minimum of 9 months drying time, unless confirmed, to ensure that the wood is dry given the variation in wood drying with different storage options. The same study determined that wood cut in the fall dries much more slowly and essentially stops drying once the wood becomes frozen. At this time the community lacks adequate storage space to dry the wood required to fill the commercial market. The summer of 2020 would be used by the commercial wood sellers to secure the space and construct structures to air dry the wood. Cord wood harvested during the spring of 2021 could then be stored and dried by October 2021 which is the most expeditious schedule that the commercial wood industry can follow to meet the requirements of this rule.

ADEC received a number of comments suggesting that the sale of 8-foot round logs should be allowed to continue in the future. These comments asserted that many buyers of 8-foot rounds have multi-year storage capacity and process their logs years in advance to ensure proper seasoning. ADEC recognizes that 8-foot rounds cannot be burned as is, but must be processed by the buyer so this wet wood can't be immediately burned without some up front effort. This means that buyers can't easily or unintentionally add this wood to their heating device. ADEC is therefore revising the final regulations to accommodate the continued sale of 8 foot rounds, but has added provisions that these sales can only occur if the wood seller confirms that the buyer will not burn wet wood in the coming season based on dry wood supply and storage/processing capacity for seasoning wood.

These requirements ensure that wood sold in Fairbanks after October 1, 2021 will have a moisture content of less than 20% and will exceed the dry wood requirements mandated in Measure 31; they also address EPA's comments.

Conclusion

The adoption of the referenced state regulations are more than sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 32: Require Dry Wood to be Clearly Labeled to Prohibit Marketing of Non-Dry Wood as Dry Wood

Implementing Jurisdiction(s)

- South Coast Air Quality Management District; San Joaquin Valley Air Pollution Control District; Bay Area Air Quality Management District

Regulation Weblinks(s)

- https://www.arb.ca.gov/drdb/sc/curhtml/R445.PDF
- http://www.valleyair.org/rules/currntrules/r4901.pdf
- http://www.baaqmd.gov/~/media/files/planning-and-research/rules-and-regs/reg-06/rg0603.pdf?la=en

Background

SCAQMD's Rule 445 limits the sale of commercial firewood to be seasoned only firewood from July 1 through the end of February the following year. Seasoned firewood is defined to have a moisture content 20 percent or less by weight as determined by approved hand held moisture meters or an alternate method defined by the California Air Resources Board. Rule 445 also contains labeling requirements:

> *Effective November 4, 2013, no commercial firewood seller shall sell, offer for sale, or supply wood-based fuel without first attaching a permanently affixed indelible label to each package or providing written notice to each buyer at the time of purchase of bulk firewood that at a minimum, states the following:*
>
> *Use of this and other solid fuel products may be restricted at times by law. Please check (1-877-4NO-BURN) or (www.8774NOBURN.org) before burning.*
>
> San Joaquin Valley AQMD's Rule 4901 has firewood marketing restrictions:
>
> *No person shall sell, offer for sale, or supply any wood which is orally or in writing, advertised, described, or in any way represented to be "seasoned wood" unless the wood has a moisture content of 20 percent or less by weight*
>
> Bay Area AQMD Regulation 6 also has requirements governing the sale of wood:
>
> *Any person offering for sale, selling or providing solid fuel or wood intended for use in a wood-burning device within District boundaries shall:*
>
> *Attach a label to each package of solid fuel or wood sold that states the following:*
>
> *"Use of this and other solid fuels may be restricted at times by law. Please check 1-877-4-NO-BURN or http://www.8774noburn.org/ before burning."*

If wood is seasoned (not to include manufactured logs), then the label must also state the following:

"This wood meets air quality regulations for moisture content to be less than 20 % (percent) by weight for cleaner burning."

Analysis

Current Alaska regulations[53] require mandatory registration of commercial wood sellers, the use of uniquely numbered three-part moisture disclosure forms, which document the date the wood was cut and findings of moisture measurements of three pieces of wood for each cord sold. The wood seller is required to sign the form, date when it was delivered and obtain signature of the customer purchasing the wood. The wood seller is also required to provide the customer with a copy of the signed disclosure form and submit to the state the department's copy of the completed disclosure form. The state is assembling the submitted forms into an electronic data base to track the moisture levels and volume of wood sold. Separate requirements address wood measurements and deliveries at temperatures below 32° F. All wood with measurements exceeding 20% is assumed to be wet.

The moisture disclosure forms require the buyer to declare:

I understand that starting October 2015, only dry wood may be burned between October 1 and March 31.

While Alaska does not require firewood to be labeled, it does require the buyer to sign a form documenting whether the wood is seasoned or unseasoned.

Current ADEC requirements to have the customer sign a form documenting whether the wood is seasoned or unseasoned ensures that the customer has seen information about the moisture content of the wood being purchased. ADEC's requirement is more stringent than other labeling requirements which the customer may or may not see, let alone acknowledge.

While current ADEC regulations require wood sellers to document and distribute detailed information regarding the moisture content of the wood, there is no regulation limiting or prohibiting the sale wet wood. Wet wood sold and delivered during the winter months, when the average temperature is below freezing, will not dry to below 20% moisture content during that winter season and some fraction of wet wood delivered during the winter months will be burned during that winter resulting in excess emissions. SCAQMD Rule 445 limits the sale of commercial firewood to be seasoned only firewood from July 1 through the end of February the following year, eliminating excess emissions from commercially sold wet wood, and is therefore more stringent than current ADEC regulations.

[53] https://dec.alaska.gov/air/anpms/sip/18aac50-reference-materials/

As discussed above in the analysis of Measure 32, wood sellers currently lack the infrastructure required to dry and store a season's worth of commercial firewood. Time will be required for wood sellers to secure the space and construct the structures to air dry wood. The summer of 2020 will be the earliest opportunity for commercial wood sellers to secure the space and construct structures to air dry the wood. Cord wood harvested during the spring of 2021 could then be stored and dried by October 2021 which is the most expeditious schedule that the commercial wood industry can follow to meet the requirements of this rule.

ADEC has therefore proposed to adopt regulations in 18 AAC 50.076 (d)(e)&(g) that require commercial wood sellers to sell only dry wood year round after October 1, 2021. Subsection(j) includes requirements to ensure that wood with a less than 20% moisture content is being sold after the effective date. 18 AAC 50.076 (k) has set the minimum of 9 months drying time, unless confirmed, to ensure that the wood is dry given the variation in wood drying with different storage options. 18 AAC 50.076 (l) would limit non-commercial sellers to selling dry wood. Dry wood is defined as below 20% moisture content. Monitoring, recordkeeping, and reporting requirements are also included in the proposed regulations to ensure compliance with the 20% moisture standard. The adoption of proposed modifications to regulation 18 AAC 50.076 are sufficient to meet BACM requirements for this control measure.

As noted above, ADEC received a number of comments suggesting that the sale of 8-foot round logs should be allowed to continue in the future. These comments asserted that many buyers of 8-foot rounds have multi-year storage capacity and process their logs years in advance to ensure proper seasoning. ADEC recognizes that 8-foot rounds cannot be burned as is, but must be processed by the buyer so this wet wood can't be immediately burned without some up front effort. This means that buyers can't easily or unintentionally add this wood to their heating device. ADEC is therefore revising the final regulations to accommodate the continued sale of 8 foot rounds, but has added provisions that these sales can only occur if the wood seller confirms that the buyer will not burn wet wood in the coming season based on dry wood supply and storage/processing capacity for seasoning wood.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 33: Burn Permits Required

Implementing Jurisdictions

- Klamath County, Feather River AQMD

Regulation Weblink(s)

- http://www.co.klamath.or.us/EH/Air%20Quality%20&%20Burning/Klamath%20County%20Clean%20Air%20Ordinance.htm

- https://www.arb.ca.gov/drdb/fr/curhtml/r3-17.pdf

Background

Klamath County OR requires persons conducting open burning to adhere to all local and state fire protection rules and restrictions, including possession of any required local burn permit issued by a local fire agency (Section 406.100.4.c). This regulation also prohibits open burning during burning curtailment periods (Section 406.100.4.a).

Feather River Air Quality Management District CA requires valid burn permits issued by the agency for all open burning with the exception of the burning of vegetation at one- or two-family residences on parcels less than two acres in size provided that requirements of fire protection services are met. (Section 2.0.H) Burn permits are invalid on No Burn Days declared by the agency. (Section 2.0.J.6)

The Alaska Department of Environmental Conservation requires written approval from the agency for the open burning of woody debris removed from sites greater than 40 acres in size on land being cleared for farming or development, prescribed burning of sites greater than 40 acres in size by land management agencies, fire fighter training burns, and the burning of materials that produce black smoke (Section 18 AAC 50.065.(g), (h), (i)). Department regulations also prohibit open burning in $PM_{2.5}$ nonattainment areas between November 1 and March 31 (Section 18 AAC 50.065.f). The definition of open burning in DEC regulations (Section 18 AAC 50.990.65) does not include campfires or ceremonial fires. The only use of such fires during the winter heating season in Fairbanks is for a handful of very small ice fishing huts for warming purposes. Ice fishing ceases when ambient temperatures reach subzero levels that are typical of Stage 1 alert periods.[54]

EPA commented that Stage 1 Alerts were referred to multiple times and asked that the analysis clarify whether the measure applied during all stages of the Alert and the level of control with each stage. EPA also commented that multiple measures "identify that recreational fires have been exempted from existing regulations. Small unregulated recreational fires, bonfires, fire pits, and warming fires have the potential to contribute emissions during a curtailment period. The FNSB and ADEC regulations should be re-evaluated for removing this exclusion."

Analysis

Although the requirements to possess burn permits for open burning are more restrictive in Klamath County and Feather River AQMD, such permit programs – if adopted by Alaska DEC – would not reduce $PM_{2.5}$ emissions during Stage 1 Alerts as existing DEC regulations ban open burning both during the winter heating season and address EPA's concern about their application to different Alert stages. The removal of the ceremonial fire exemption will have no measureable emissions benefit in the Fairbanks nonattainment area, thus EPA's comments are not relevant. EPA also commented that Klamath County and Feather River measures were more stringent than

[54] Personal communication between Nicholas Czarnecki, FNSB Air Quality Division, and Bob Dulla, Trinity Consultants, on January 25, 2018.

the Fairbanks Code requirements. As noted earlier, those regulations were removed from Borough Code following voter approval of the Home Heating Reclamation Act, thus EPA's comment related to Borough stringency is no longer relevant.

Conclusion

The burn permit measures adopted by Klamath County and Feather River AQMD are less stringent than the Alaska DEC ban on open burning during the wood heating season. Thus, these measures have been adopted in different form and no additional analysis is required.

Measure 34: Prohibit Burn Barrels and Other Outdoor Equipment

Implementing Jurisdiction(s)

- Klamath County

Regulation Weblink(s)

- http://www.co.klamath.or.us/EH/Air%20Quality%20&%20Burning/Klamath%20County%20Clean%20Air%20Ordinance.htm

Background

Klamath County OR prohibits the use of burn barrels and other outdoor burning devices. (Section 406.150.2.c)

Alaska DEC prohibits the use of burn barrels and non-permitted incinerators during the wood heating season from November 1 through March 31. (18 AAC 50.065.f)

EPA commented that "Measure 34 is less stringent in Fairbanks than in Klamath County. Uncertainty in weather forecasting means that Stage 1 alerts are not called correctly all the time, and not everyone is aware of when an alert is in effect. It is much simpler and less prone to error to prohibit burn barrels and outdoor burning devices entirely."

Analysis

Although Klamath County bans use of burn barrels and other outdoor burning devices throughout the year, the Alaska DEC ban on the use of burn barrels and non permitted incinerators during the wood heating season from November 1 through March 31 in the Fairbanks nonattainment area results in the same level of emission control from these devices during burning curtailment periods. These requirements directly address EPA's concerns.

Conclusion

This measure as adopted by Klamath County is not more stringent than the corresponding requirement in existing Alaska DEC regulations that have been adopted in different form and, thus, no additional analysis is required.

Measure 35: Restrict Burning During Air Pollution Events

Implementing Jurisdiction(s)

- Klamath County; Ada County

Regulation Weblink(s)

- http://www.co.klamath.or.us/EH/Air%20Quality%20&%20Burning/Klamath%20County%20Clean%20Air%20Ordinance.htm
- http://www.sterlingcodifiers.com/codebook/index.php?book_id=447

Background

Klamath County OR prohibits open burning during burning curtailment periods (Section 406.100.4.a). Oregon Department of Environmental Quality regulations exempt recreational fires and ceremonial fires from open burning requirements (Section 340-264-0040).

Ada County ID prohibits the open burning of refuse or solid fuel during declared air quality alerts (Section 5-10-8.C). County regulations also exempt recreational or warming fires from open burning restrictions provided that such fires do not violate air pollution alerts (Section 5-2-7-2.D).

Alaska Department of Environmental Conservation prohibits open burning in $PM_{2.5}$ nonattainment areas between November 1 and March 31 (Section 18 AAC 50.065.f). These regulations also exempt ceremonial fires from open burning restrictions (Section 18 AAC 50.990.65.B).

EPA commented that multiple measures "identify that recreational fires have been exempted from existing regulations. Small unregulated recreational fires, bonfires, fire pits, and warming fires have the potential to contribute emissions during a curtailment period. The FNSB and ADEC regulations should be re-evaluated for removing this exclusion."

Analysis

The measures adopted by Klamath County and Ada County contain the same exemptions from open burning restrictions for recreational fires as are contained in the Alaska regulations. Exempt fires are rarely ignited in Fairbanks when ambient temperatures reach subzero levels that

are typical during Stage 1 Alert periods.[55] The removal of the ceremonial fire exemption will have no measurable emissions benefit in the Fairbanks nonattainment area, thus EPA's comments are not relevant.

40 CFR 51.1000 defines BACM as a control measure that "generally can achieve greater permanent and enforceable emission reductions … than can be achieved through implementation of RACM". Given that the measure does not result in a quantifiable emission benefit this control measure does not meet the definition of BACM.

With no quantifiable emission benefit and some associated cost to implement, the dollar per ton value would be infinite which shows economic infeasibility as well.

Conclusion

These measures as adopted by Klamath County and by Ada County do not meet the definition of BACM and are economically infeasible. These measures have been dismissed from the BACM analysis.

Measure 36: Prohibit Residential Open Burning

Implementing Jurisdiction(s)

- South Coast AQMD

Regulation Weblink(s)

- http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-444.pdf
- http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-445.pdf?sfvrsn=4

Background

The South Coast Air Quality Management District prohibits residential open burning within its jurisdiction (Section 444.d.3.A). This rule also exempts recreational fires and ceremonial fires from the prohibition on residential open burning (Section 444.h.6.A). South Coast AQMD regulations also prohibit the operation of wood burning devices during mandatory winter burning curtailment periods (Section 445.e) but exempts ceremonial fires, as exempted under Rule 444, from curtailment requirements (Section 445.f.7.E).

Alaska Department of Environmental Conservation prohibits open burning in $PM_{2.5}$ nonattainment areas between November 1 and March 31 (Section 18 AAC 50.065.f). These regulations also exempt ceremonial fires from open burning restrictions (Section 18 AAC 50.990.65.B).

[55] Personal communication between Nicholas Czarnecki, FNSB Air Quality Division, and Bob Dulla, Trinity Consultants, on January 25, 2018.

EPA commented that multiple measures "identify that recreational fires have been exempted from existing regulations. Small unregulated recreational fires, bonfires, fire pits, and warming fires have the potential to contribute emissions during a curtailment period. The FNSB and ADEC regulations should be re-evaluated for removing this exclusion."

Analysis

The South Coast AQMD measure authorizes ceremonial fires during a mandatory winter burning curtailment period. However, the South Coast AQMD regulations do not contain definitions of either "ceremonial fires" or "recreational fires". Although the Alaska DEC exemptions from open burning for campfires and ceremonial fires is no less restrictive than the South Coast exemption for ceremonial fires, campfires or ceremonial fires are rarely ignited during Stage 1 Alert periods in Fairbanks because of the ambient subzero temperatures that typically occur during these periods. The removal of the ceremonial fire exemption will have no measureable emissions benefit in the Fairbanks nonattainment area, thus EPA's comments are not relevant.

Conclusion

This measure as adopted by South Coast AQMD is not more stringent than the corresponding requirements in existing Alaska DEC regulations that have been adopted in different form and, thus, no additional analysis is required.

Measure 37: Periodic Burn Windows

Implementing Jurisdictions

- Klamath County

Regulation Weblink(s)

- http://www.co.klamath.or.us/EH/Air%20Quality%20&%20Burning/Klamath%20County%20Clean%20Air%20Ordinance.htm
- https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=76168

Background

Klamath County OR authorizes the Environmental Health Division Manager, in consultation with specified county, city, and local fire officials, to limit residential open burning to two 15-day periods each year (Section 406.150.2.a). If declared, one window must occur in the spring and one in the fall. Open burning is prohibited during burning curtailment periods (Section 406.100.4.1). The definition of residential open burning in Oregon Department of Environmental Quality regulations excludes recreational fires and ceremonial fires (Section 340 264-0040.1).

Alaska Department of Environmental Conservation prohibits open burning in $PM_{2.5}$ nonattainment areas between November 1 and March 31 (Section 18 AAC 50.065.f). These regulations also exempt ceremonial fires from open burning restrictions (Section 18 AAC 50.990.65.B).

EPA commented that multiple measures "identify that recreational fires have been exempted from existing regulations. Small unregulated recreational fires, bonfires, fire pits, and warming fires have the potential to contribute emissions during a curtailment period. The FNSB and ADEC regulations should be re-evaluated for removing this exclusion."

Analysis

The Klamath County and Oregon DEQ regulations authorize the setting of residential open burning windows to limit the days each year when such open burning may be conducted, but the requirement limiting these to the spring and fall means that none of these windows will occur during the winter heating season. Regardless, Klamath County prohibits residential open burning during burning curtailment periods. The Alaska DEC regulations ban all residential open burning during the winter heating season in the Fairbanks $PM_{2.5}$ nonattainment area. Both Oregon and FNSB regulations exempt recreational and ceremonial fires from residential open burning prohibitions. The removal of the ceremonial fire exemption will have no measureable emissions benefit in the Fairbanks nonattainment area, thus EPA's comments are not relevant.

Conclusion

This measure as adopted by Klamath County is not more stringent than the corresponding requirements in existing Alaska DEC regulations that have been adopted in different form and, thus, no additional analysis is required.

Measure 38: Ambient $PM_{2.5}$ Curtailment Threshold (1-Hr Average)

Applicable Jurisdiction(s)

- Cache Valley and Cities, Idaho

Regulation Weblink(s)

- https://adminrules.idaho.gov/rules/2014/58/0101.pdf

Background

Many jurisdictions with wood smoke control programs have adopted specific air quality thresholds for triggering burn bans, or curtailments, during which certain activities that produce $PM_{2.5}$ emissions are prohibited, or at least severely restricted. The Idaho Department of Environmental Quality (IDEQ) is the only regulatory agency found to trigger curtailment periods on the basis of ambient $PM_{2.5}$ levels measured over 1-hour averaging periods. Most other air quality agencies with burn ban authority base curtailment decisions on $PM_{2.5}$ levels averaged

over 12- to 24-hour periods. Most importantly, this local 1-hour threshold in the Cache Valley and cities of Idaho applies only to curtailment or cessation of open burning, not wood-based residential space heating.

Under the Idaho Administrative Code, IDEQ has the authority to issue a Stage 1 Forecast and Caution when "particulate concentrations reach, or are forecasted to reach, and persist, at or above the levels listed" in the table below.[56] Under the Stage 1 Air Pollution Forecast and Caution, "there shall be no new ignition of open burning of any kind." In addition, the director of the IDEQ may request the cessation of open burning. (Again, this Stage 1 Forecast and Caution applies only to open burning and does not apply to residential wood heating.)

Table 8. Stage 1 Forecast Levels

Pollutant	Standard
$PM_{2.5}$	80 µg/m^3 1 hour average
$PM_{2.5}$	50 µg/m^3 24 hour average
PM_{10}	385 µg/m^3 1 hour average
PM_{10}	150 µg/m^3 24 hour average

This authority is also found in IDEQ's Air Pollution Emergency Rule.[57]

Analysis

Discussions with staff members of IDEQ[58] and the Utah Department of Environmental Quality (UDEQ)[59] found the jurisdictions share a common $PM_{2.5}$ nonattainment area and thus coordinate regulations on many air quality issues; they indicated that the 1-hour standard is outdated and no longer used. Staff members from UDEQ indicated that they had no regulations based upon 1-hour standards and that all regulations were based upon 24-hour averaging periods. The $PM_{2.5}$ thresholds, for example, have never been updated to correlate to the current NAAQS standards. Staff from IDEQ instead use a 24-hour concentration of 30 µg/m^3 as a curtailment threshold and are considering a lowering of their 24-hour standard if that proposed by Utah is accepted and required by EPA.

Moreover, the Alaska Department of Environmental Conservation (ADEC) already has a state regulation in place[60] that prohibits open burning in the Fairbanks $PM_{2.5}$ nonattainment area

[56] Idaho Department of Environmental Quality, Idaho Administrative Code, Rules for the Control of Air Pollution in Idaho, IDAPA 58.01.01, available at https://adminrules.idaho.gov/rules/2014/58/0101.pdf; Accessed October/10/2017.
[57] https://www.deq.idaho.gov/media/344469-emerg_rule_fs.pdf; Accessed October 10, 2017.
[58] Personal communication with Melissa Gibbs, Idaho Department of Environmental Quality, October 5, 2017.
[59] Personal communications with Bo Call, Utah Department of Environmental Quality, October 4, 2017; Personal communication with Joel Karmazyn, October 5, 2017.
[60] 18 AAC 50.065

between November 1 and March 31, the period that essentially corresponds to historical $PM_{2.5}$ violations.

The 1-hour concentration-based threshold adopted in Idaho applies to curtailment/cessation of open burning, not residential space heating. ADEC's existing regulation (18 AAC 50.065) prohibits open burning in the nonattainment area during the winter season. Thus, implementation of the Idaho 1-hour average threshold for curtailing open burning would have no impact on wood smoke emissions during the wintertime nonattainment season in Fairbanks, and is not applicable to curtailment or restrictions on residential space heating. In summary, ADEC's ban on open burning during the winter season is more stringent than this measure.

40 CFR 51.1000 defines BACM as a control measure that "generally can achieve greater permanent and enforceable emission reductions … than can be achieved through implementation of RACM". Given that the measure does not result in a quantifiable emission benefit this control measure does not meet the definition of BACM.

With no quantifiable emission benefit and some associated cost to implement, the dollar per ton value would be infinite which shows economic infeasibility as well.

Conclusion

The adoption of this measure will provide no emissions benefit in the Fairbanks nonattainment area, therefore the measure does not meet the definition of BACM and is economically infeasible. This measure has been dismissed from the BACM analysis.

Measure 39: Use of AQI as Basis for Curtailment Threshold

Applicable Jurisdiction(s)

- Cache Valley and Cities, Idaho

Regulation Weblink(s)

- http://www.deq.idaho.gov/media/930593-cache-valley-pm2-5-sip-appendices-1212.pdf

Background

Franklin County and the Cache Valley cities in Idaho use a $PM_{2.5}$ Air Quality Index (AQI) level of 75 as the threshold for declaring a burn ban (curtailment) for residential wood stoves. This level is equivalent to an ambient concentration of 23.5 $\mu g/m^3$.[61] Most other jurisdictions that regulate residential wood burning specify $PM_{2.5}$ concentration-based thresholds for a curtailment declaration (typically in the 25-35 $\mu g/m^3$ range) rather than specifying AQI levels. ADEC's concentration based thresholds for Stage 1 and Stage 2 are 20 and 30 $\mu g/m^3$.

[61] https://airnow.gov/index.cfm?action=airnow.calculator

The Cache Valley attainment plan submitted to the EPA by the Idaho Department of Environmental Quality states, in many locations, that burning is prohibited when the AQI for the region reaches 75 or higher.[62] The restriction applies, in one section, to "all wood burning, including but not limited to, within a solid fuel heating appliance designed for wood fuel (commonly known as a 'wood stove') or open fireplace" and in another to "any open burning of any kind."

Analysis

Personal communication with Idaho DEQ[63] staff suggested that the adoption of an AQI-based threshold rather than a $PM_{2.5}$ concentration-based threshold was motivated solely by the desire to avoid having to rewrite regulations to modify the "trigger level" when EPA revised the NAAQS. The AQI is itself a function of the NAAQS standard and so, when the standard is reduced by EPA, the concentration equivalent to an AQI of 75 – or any other measure of AQI – would correspondingly be reduced as well.[64] Thus the jurisdiction would not need to modify its regulation in response to a NAAQS change. The staff member indicated that no documentation existed to suggest whether the use of AQI- or concentration-based thresholds would be more effective at reducing emissions.

Further communication with the Idaho DEQ suggested that the use of an AQI- rather than a concentration-based threshold did not likely affect the compliance rate of affected woodstoves and that the news release containing the curtailment order typically did not even mention the criteria used to initiate the curtailment.

40 CFR 51.1000 defines BACM as a control measure that "generally can achieve greater permanent and enforceable emission reductions … than can be achieved through implementation of RACM". Given that the measure does not result in a quantifiable emission benefit this control measure does not meet the definition of BACM.

With no quantifiable emission benefit and some associated cost to implement, the dollar per ton value would be infinite which shows economic infeasibility as well.

Conclusion

Given the equivalence between AQI and $PM_{2.5}$ concentrations thresholds the question of technological feasibility depends on the stringency of adopted AQI thresholds; therefore, this

[62] Idaho Department of Environmental Quality, Cache Valley Idaho $PM_{2.5}$ Nonattainment Area SIP, Appendix E: Reasonably Available Control Methods, 2006, available at http://www.deq.idaho.gov/media/930593-cache-valley-pm2-5-sip-appendices-1212.pdf; Accessed October 10, 2017.
[63] Personal communication with Melissa Gibbs, Idaho Department of Environmental Quality, October 5, 2017.
[64] Calculator for AQI maintained by EPA at https://airnow.gov/index.cfm?action=airnow.calculator

measure provides no emission benefit and does not meet the definition of BACM and is economically infeasible. This measure has been dismissed from the BACM analysis.

Measure 40: Single Stage Curtailment

Applicable Jurisdiction(s)

- Bay Area Air Quality Management District (SF Bay Area, CA)

Regulation Weblink(s)

- http://www.baaqmd.gov/~/media/files/planning-and-research/rules-and-regs/reg-06/rg0603.pdf?la=en

Background

The Fairbanks Borough had two stages for the curtailment of wood stove activity in response to a decrease in air quality. Under Stage 1, the use of non-certified devices is banned within the nonattainment region. Under Stage 2, when elevated from Stage 1, the use of all wood-burning devices is banned within the nonattainment region.[65] Thus, those with EPA-certified burning devices were allowed to use them during Stage 1 but not during Stage 2. Borough regulations were removed following voter approval of the Home Heating Reclamation Act. The State regulations follow the SIP Episode Plan with the 2-Stage curtailment approach.

Other jurisdictions have mandatory burn bans, or curtailment periods, that consist of only one phase. Once the period has been initiated, activity is banned for all burning devices. One such jurisdiction is the Bay Area Air Quality Management District (BAAQMD). The initial regulation, adopted in 2008, makes mention of only one stage of curtailment. Upon proposal of the regulation for consideration by the BAAQMD Board, BAAQMD staff only estimated the overall emission reduction that could be anticipated from the mandatory curtailment provision; they made no comparison of those emission reductions to those that could be anticipated with a two-stage curtailment program.[66]

EPA commented that "Measure 40 needs to include a discussion of all the areas listed on page 22. In addition, if a date certain measure or if Measure 29 were instituted, Measure 40 would essentially be achieved." (emphasis added)

Analysis

[65] Fairbanks North Star Borough Air Quality Division, 2017, available at http://fnsb.us/transportation/AQDocs/AQ%20resource%20guide%20April%202017.pdf; accessed October 25, 2017.
[66] BAAQMD, 2008, Staff Report: Proposed New Regulation 6: Particulate Matter, Rule 3: Wood-burning Devices Amendments to Regulation 1: General Provisions and Definitions, and Regulation 5: Open Burning, received from personal correspondence with Marcy Hiratzka, BAAQMD, October 25, 2017.

Other jurisdictions, however, have actually compared the single-stage and double-stage options. For example, the Sacramento Metropolitan Air Quality Management District, in 2009, conducted a direct comparison of both options. Staff evaluated the benefits of lowering stage thresholds to strengthen Rule 421. Two options were considered:

Option A – change to a single-stage program and eliminate the exemption for EPA certified wood stoves and pellet stoves. And, set the No Burn Threshold to 30 µg/m^3 and either maintain the voluntary threshold at 20 µg/m^3 or reduce it to 20 µg/m^3.

Option B – reduce the Stage 1 threshold to 25 µg/m^3 and the Stage 2 threshold to 30 µg/m^3 to be consistent with San Joaquin Valley No Burn Threshold. Also reduce the voluntary threshold to 20 µg/m^3.

The analysis led staff to recommend Option A. Public comment about the reduced incentive to convert to cleaner burning devices however caused staff to change their recommendation to maintain a two Stage program with reduced thresholds: Stage 1 lowered from 35 to 31 µg/m^3 and a Stage 2 threshold lowered from 40 to 35 µg/m^3. The staff report noted the following:

> *However, many comments at the workshop expressed concern that eliminating a two-stage program, with its exemption for EPA certified devices and pellet stoves on Stage 1 days, would reduce the incentive for people to switch to cleaner devices and also be unfair to those who have already invested in cleaner devices.*[67]

While the analysis demonstrated an increase in the number of curtailment days at lower thresholds, the impact on the estimate of avoided exceedance days did not account for the reduced incentive to invest in cleaner devices. It also did not account for the impact of the increased # of curtailment days on the compliance rate (it was assumed to be unchanged).

As discussed earlier Alaska has added several new regulations which directly address the measure and EPA's comments. First in Measure 16, the analysis noted that Alaska's new regulations 18 AAC 50.077(a)&(l) specify that a person may not install, reinstall, sell, lease, distribute, or convey wood-fired heating devices that lack a valid EPA certification under 40 C.F.R. 60.533 or any wood-fired outdoor hydronic heaters, except pellet fueled devices. All noncompliant devices must be rendered permanently inoperable by December 31, 2024, prior to property conveyance.

Second, Measure 29's analysis noted, Utah calls burn bans when concentrations are forecast to reach or exceed 25 µg/m^3. Alaska's Episode Chapter of the $PM_{2.5}$ Serious SIP will call Stage 1 Alerts when concentrations are forecast to exceed 20 µg/m^3 and Stage 2 Alerts at 30 µg/m^3. Emission reductions from Alaska's more stringent curtailment thresholds far exceed those that

[67] Sacramento Metropolitan Air Quality Management District, 2009, Staff Report: Rule 421, Mandatory Episodic Curtailment of Wood and Other Solid Fuel Burning, available at http://www.airquality.org/ProgramCoordination/Documents/Rule421%20StaffReport%20082409.pdf; accessed October 25, 2017.

would be produced by adoption Measure 29 for the Fairbanks $PM_{2.5}$ nonattainment area, therefore satisfying EPA's comment.

Collectively, these new regulations which the state will enforce under the Episode Chapter of the $PM_{2.5}$ Serious SIP provide significantly greater emission reductions than the single stage requirements of this measure.

Conclusion

The adoption of the referenced Episode Chapter requirements are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 41: Special Needs Permit

Implementing Jurisdiction(s)

- Missoula City-County MT

Regulation Weblink(s)

- https://www.missoulacounty.us/home/showdocument?id=8452

Background

The Missoula City-County Air Pollution Control Program exempts households with valid Special Needs Permits from curtailment burning bans (Section 9.207). To qualify for a Special Needs Permit, an applicant must demonstrate an economic need to burn solid fuel for space heating purposes by qualifying for energy assistance according to economic guidelines of the federal Low-Income Energy Assistance Program. Special Need Permits are valid for one year and may be renewed if the applicant continues to meet the applicable heating need and qualifies for energy assistance.

Alaska DEC regulations authorize the Department to grant a temporary waiver allowing the burning of solid fuel for space heating purposes during an air quality episode only if opacity limits are met and the owner or operator obtains a temporary waiver based:

- financial hardship as demonstrated by documentation provided to the Department;
- technical feasibility and device design information;
- potential impact to sensitive populations;
- mitigation measures implemented by the owner; and
- the contribution of the device to the exceedance.

Analysis

Missoula City-County automatically grants one-year exemptions to owners or operators who satisfy specific hardship qualifications. Alaska DEC regulations give the Department discretion as to the granting of a temporary waiver based on more criteria than solely economic hardship.

Conclusion

As the Alaska DEC temporary waiver is discretionary and the Missoula City-County exemption is ministerial, the Missoula City-County measure is not more restrictive than the corresponding regulation currently enforced by Alaska DEC that have been adopted in different form and, thus, no additional analysis is required.

Measure 42: Burn Down Period

Implementing Jurisdiction(s)

- Puget Sound CAA; Maricopa County

Regulation Weblink(s)

- http://www.pscleanair.org/219/PSCAA-Regulations
- http://www.maricopa.gov/DocumentCenter/View/5332

Background

The Puget Sound Clean Air Agency requires solid fuel burning devices to be shut down when a First Stage of Impaired Air Quality (curtailment) has been declared (Sections 13.05.a.1 and 13.05.d.1.a). Certain categories of devices, such as pellet stoves, Oregon DEQ-certified Phase 2 devices, Washington DOE-certified devices, and devices in households with no other adequate source of heat, are allowed to continue operating during a curtailment period provided that all applicable registration requirements are met. When a curtailment period is declared, fuel to non-exempt devices must be withheld, and combustion in these devices – as evidenced by visible smoke from a chimney – must cease within three hours after the declaration is issued (Section 13.05.b).

Maricopa County defines "Burn-Down Period" as "That period of time, not to exceed three hours after declaring a restricted-burn period, required for the cessation of combustion within any residential wood-burning device, outdoor fire pit, wood-burning chimney, or similar outdoor fire by withholding fuel or by modifying the air-to-fuel-ratio" (Section P-26.2.D). This regulation also stays enforcement of visible emission limits for three hours after a curtailment declaration is issued (Section P-26.3.D.4).

Fairbanks' regulations did not specifically exempt smoke emitted during burn down periods from compliance with opacity limits, but do exempt visible emissions from a chimney in excess of the opacity standard for a period not to exceed 30 minutes during a curtailment period before citing unauthorized wood heating devices for unlawful operation during a curtailment period. Those regulations were removed following the passage of the Home Heating Reclamation Act.

Analysis

Alaska added a regulation subsection 18 AAC 70.075(e)(3) "that fuel to non-exempt devices must be withheld, and combustion in these devices – as evidenced by visible smoke from a chimney – must cease within three hours of the effective time of the declaration."

The addition of this subsection matches the burn down requirements set in Measure 42. Therefore, the adoption of this measure will provide no emission benefits in Fairbanks.

The Serious SIP is a chapter of the State Air Quality Control Plan that is adopted by reference into state regulation at 18 AAC 50.030. As a result, the Fairbanks Emergency Episode Plan as described in Section III.D.7.12 is enforceable by ADEC. This section of the SIP outlines for the public the specifics related to episodic control requirements within the nonattainment area along with the process ADEC uses for announcing episodes. ADEC revised Section III.D.7.12 to incorporate the language added to 18 AAC 50.075(e) to ensure that the burn down requirements are clearly identified within the local Episode Plan.

ADEC also uses a fixed episode announcement template that will have the burn down language included so that every curtailment called within the nonattainment area will contain the burn down language.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 43: Exempt Ceremonial or Religious Fires

Implementing Jurisdictions

- South Coast AQMD

Regulation Weblink(s)

- http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-444.pdf
- http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-445.pdf?sfvrsn=4

Background

The South Coast Air Quality Management District prohibits residential open burning within its jurisdiction (Section 444.d.3.A). This rule also exempts recreational fires and ceremonial fires from the prohibition on residential open burning (Section 444.h.6.A). South Coast AQMD regulations also prohibit the operation of wood burning devices during mandatory winter burning

curtailment periods (Section 445.e) but exempts ceremonial fires, as exempted under Rule 444, from curtailment requirements (Section 445.f.7.E).

Alaska Department of Environmental Conservation prohibits open burning in $PM_{2.5}$ nonattainment areas between November 1 and March 31 (18 AAC 50.065(f)). These regulations also exempt ceremonial fires from open burning restrictions (18 AAC 50.990(65)(B)).

EPA commented that multiple measures "identify that recreational fires have been exempted from existing regulations. Small unregulated recreational fires, bonfires, fire pits, and warming fires have the potential to contribute emissions during a curtailment period. The FNSB and ADEC regulations should be re-evaluated for removing this exclusion."

Analysis

The South Coast AQMD measure authorizes ceremonial fires during a mandatory winter burning curtailment period. However, the South Coast AQMD regulations do not contain definitions of either "ceremonial fires" or "recreational fires". Alaska DEC regulations exempt campfires and ceremonial fires from the ban on open burning during Stage 1 Alerts. The adoption by Alaska DEC of the South Coast AQMD exemption granted to ceremonial or religious fires would not reduce emissions during Stage 1 Alerts since Alaska DEC currently exempts campfires and recreational fires from burning curtailment requirements. The removal of the ceremonial fire exemption will have no measurable emissions benefit in the Fairbanks nonattainment area, thus EPA's comments are not relevant.

Conclusion

This measure as adopted by South Coast AQMD is not more stringent than the corresponding requirements in existing Alaska DEC regulations that have been adopted in different form and, thus, no additional analysis is required.

Measure 44: Alternative Heating Appliance Failure

Implementing Jurisdiction(s)

- Missoula City-County, Maricopa County, Klamath County

Regulation Weblink(s)

- https://www.missoulacounty.us/home/showdocument?id=8452
- http://www.maricopa.gov/DocumentCenter/View/5332
- http://www.co.klamath.or.us/EH/Air%20Quality%20&%20Burning/Klamath%20County%20Clean%20Air%20Ordinance.htm

Background

The Missoula City-County Air Pollution Control Program allows residents to apply for a temporary sole source permit in an emergency situation where the resident demonstrates his furnace or central heating system is inoperable other than through his own actions, where the furnace or central heating system is involuntarily disconnected from its energy source by a utility or fuel supplies, or where the normal fuel or energy source is unavailable for any reason (Section 9.208.2). The temporary sole source permit allows a household to continue burning wood for heating purposes during burning curtailment periods (Section 9.208.1). Conditions related to public health endangerment and economic hardship also apply to the approval of a temporary sole source permit, and the permit is valid for a period determined by the agency but may not exceed one year (Sections 9.208.3 through 9.208.7).

Maricopa County authorizes the agency director to issue emergency exemptions from curtailment requirements to households demonstrating that the alternative heating system is inoperable for reasons other than the occupants' own actions or demonstrating that the heating system has been involuntarily disconnected by a utility company or fuel provider (Section P-26.4.C). An emergency exemption is valid only for the period determined by the agency director, but shall not exceed one year from the date of issuance.

Klamath County authorizes the Environmental Health Division to issue Emergency Condition exemptions from burning curtailment requirements when utility suppliers declare energy shortages, electric power outages occur, interruptions of natural gas supply occur, or when there is an immediate need to operate a wood heating device to protect family or individual health and safety (Section 406.150.1.f).

Alaska DEC would only exempt households from curtailment if the primary heating system fails or is unavailable.

Analysis

The use of wood heating devices during periods of alternative heating appliance failure in Missoula City-County, Maricopa County, and Klamath County is allowed under several failure modes. Alaska DEC would only allow exemptions if the primary heating system fails.

Conclusion

This measure is not more stringent than the corresponding requirement in the existing Alaska DEC regulations that have been adopted in different form and, thus, no additional analysis is required.

Measure 45: Elevation Exemption from Wood Burning Curtailments

Implementing Jurisdiction(s)

- South Coast Air Quality Management District; Utah Department of Environmental Quality

Regulation Weblink(s)

- http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-444.pdf
- https://rules.utah.gov/publicat/code/r307/r307-302.htm#T3

Background

In the South Coast, Mandatory Winter Burning Curtailment is defined to occur:

> *..during the consecutive months of November through February where the burning of solid fuels is restricted for portions of the South Coast Air Basin at elevations below 3,000 feet above Mean Sea Level (MSL) based on air quality criteria contained in AQMD Rule 445 (Wood Burning Devices).* (emphasis added)

Utah's Rule 307 (Solid Fuel Burning) provides exemption from wood burning restrictions for sources located at elevations above 7,000 feet.

Alaska DEC does not provide an elevation exemption from burning curtailment requirements.

Analysis

A review of topographical maps found that no portion of the Fairbanks $PM_{2.5}$ nonattainment area is at an elevation above 3,000 feet MSL. This finding was confirmed by the Borough's Air Quality Division. The existing Alaska DEC air quality regulations do not provide an elevation exemption from burning curtailment requirements.

40 CFR 51.1000 defines BACM as a control measure that "generally can achieve greater permanent and enforceable emission reductions … than can be achieved through implementation of RACM". Given that the measure does not result in a quantifiable emission benefit this control measure does not meet the definition of BACM.

With no quantifiable emission benefit and some associated cost to implement, the dollar per ton value would be infinite which shows economic infeasibility as well.

Conclusion

This measure would not result in a quantifiable emission benefit and thus does not meet the definition of BACM and is economically infeasible. This measure has been dismissed from the BACM analysis.

Measure 46: Lack of Electrical or Natural Gas Service Availability

Implementing Jurisdiction(s)

- South Coast Air Quality Management District; San Joaquin Valley Air Pollution Control District

Regulation Weblink(s)

- http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-445.pdf?sfvrsn=4
- https://www.valleyair.org/rules/currntrules/r4901.pdf

Background

The South Coast Air Quality Management District exempts wood heating devices from burning curtailment requirements in households where there is no existing infrastructure for natural gas service within 150 feet of the property line (Section 445.f.7.C).

San Joaquin Valley Air Pollution Control District exempts wood burning fireplaces and wood burning heaters from burning curtailment requirements in areas where natural gas service is not available (Section 4901.5.6.3.1).

Fairbanks did not exempt households from curtailment requirements due to a lack of natural gas service but it did allow all wood heating devices affected by an electrical power failure to be used for space heating purposes during Stage 1 alerts. Fairbanks curtailment requirements were removed with the passage of the Home Heating Reclamation Act.

EPA commented "The current Fairbanks curtailment exemption "These restrictions shall not apply during a power failure." should be reviewed to clarify that it only applies to homes reliant on electricity for heating. As currently written, it appears overly broad."

Analysis

As discussed in Measure 8, Fairbanks currently has natural gas service, however it is capacity constrained and will not be in a position to expand service to new customers until 2020 (i.e., after the designated attainment year).[68] Thus, the San Joaquin Valley APCD regulation, which exempts unregistered wood heating devices from curtailment requirements in areas with no natural gas service, is significantly less stringent than the Alaska regulations.

With regard to EPA's comment about restrictions during power failure, the Episode Chapter of the $PM_{2.5}$ Serious SIP, provides an exception for cases where electrical power outages prevent use of alternative heating devices. This requirement is not overly broad as electricity is required to power all alternative (i.e., non-wood) heating devices, since they require pumps, fans, resistance coils, valves, etc. for operation. Thus, with the exception of wood-fired heating there is no alternative source of heat when there is an electrical power outage, unless the home has a generator.

40 CFR 51.1000 defines BACM as a control measure that "generally can achieve greater permanent and enforceable emission reductions … than can be achieved through implementation

[68] Appendix A of the Financing Agreement between AIDEA and IGU, December 13, 2017

of RACM". Given that the measure does not result in a quantifiable emission benefit this control measure does not meet the definition of BACM.

With no quantifiable emission benefit and some associated cost to implement, the dollar per ton value would be infinite which shows economic infeasibility as well.

Conclusion

Since the adoption of this measure will provide no emission reductions in Fairbanks, it does not meet the definition of BACM and is economically infeasible. This measure has been dismissed from the BACM analysis.

Measure 47: Inspection Warrants

Implementing Jurisdiction(s)

- Aurora, CO

Regulation Weblink(s)

- https://library.municode.com/co/aurora/codes/building_and_zoning?nodeId=BUZOCO_CH146ZO_ART12SURESPUSAC_DIV1GEUS_S146-1204BURE

Background

The City of Aurora, Colorado, authorizes the city manager, through authorized representatives, to make inspections of solid fuel heating devices that are being operated during curtailment periods. If any person refuses or restricts entry to the premises or refuses inspection of any device, the city manager is required to seek from the municipal court a warrant for inspection and an order permitting inspection at a reasonable time without interference, restriction, or obstruction (Section. 146-1204.D).

Fairbanks required installations of Borough-listed solid fuel burning appliances in new construction and replacement appliances in subsidized change-outs be performed by Borough-listed vendor/installers. Fairbanks regulations, however, did not require nor authorize Borough staff to perform inspections of appliance installations or operations. Fairbanks installation requirements were removed with the passage of the Home Heating Reclamation Act.

Analysis

The City of Aurora measure authorizes city staff to inspect wood heating devices in operation during curtailment periods and, if refused access by premises occupants, are required to seek inspection warrants from the municipal court. Under AS 46.03.860. Inspection Warrant, an existing statute, DEC can seek search warrants for the purpose of investigating actual or suspected sources of pollution or contamination or to ascertain compliance or noncompliance with AS 46.14 (Alaska Statue Air Quality Control) or a regulation adopted under AS 46.14.

This authority is consistent with Measure 47. Therefore implementing this measure would provide no emissions benefit if implemented in the Fairbanks nonattainment area.

Conclusion

This measure has been adopted by the State in different form and no additional analysis is required.

Measure 48: Date Certain Removal of "Coal Only Heater"

Implementing Jurisdiction(s)

- Puget Sound Clean Air Agency

Regulation Weblink(s)

- https://www.pscleanair.org/DocumentCenter/View/354

Background

Puget Sound CAA Regulation 13.07 mandates the removal of coal-only heaters located in Tacoma:

> *Any person who owns or is responsible for a coal-only heater located in the Tacoma, Washington fine particulate nonattainment area must remove and dispose of it or render it permanently inoperable by September 30, 2015.*

It also requires that owners provide documentation of the removal and disposal or rendering permanently inoperable of the coal heater to the Agency using the Agency's procedures within 30 days of the removal or rendering the heater permanently inoperable.

Fairbanks restricted the operation and installation of coal burning devices. Coal burning stoves, hydronic heaters and furnaces are defined as solid fuel burning appliances (SFBA). None of these appliances are Borough "listed appliances". All listed appliances must be EPA-certified and have an annual average emission rating of 2.5 grams per hour or less or 0.10 lbs/mm Btu for hydronic heaters. This effectively prohibited the installation of other types of solid fuel-fired heating devices, including coal, unless the Borough approves an independent emission test showing the device meets the emission standards. Fairbanks requirements addressing the installation and operation of coal burning devices were removed with the passage of the Home Heating Reclamation Act.

The State of Alaska adopted regulations and SIP amendments which became effective January 12, 2018 that prevented unlisted appliances (i.e., coal heaters) from being installed, sold or leased for use within the Fairbanks $PM_{2.5}$ nonattainment area. They cannot be operated during

Air Quality Alerts, do not qualify for NOASH certificates, but do qualify for the enhanced voluntary, removal, replacement and repair program.

Analysis

As discussed in the Introduction, Alaska added a new subsection to 18 AAC 50.079(f) which requires coal-fired heating devices to be removed or replaced by December 31, 2024. They must be removed or replaced prior to any conveyance of an existing building and cannot be sold, leased or distributed for sale. The removed devices must be destroyed or rendered inoperable and cannot be advertised for sale within the nonattainment area.

The current device inventory estimates that approximately 13,418 wood burning appliances are in the nonattainment area with 2,553 of those appliances estimated to be uncertified. Estimates also show approximately 481 coal fired residential heaters in the nonattainment area for a total of 3,034 appliances that need to be removed. Current funding for the Borough's wood stove change out program show that, including the 2018 Targeted Air Shed grant award, the total projected change outs achievable from 2019 through 2024 are 1,290. The date of 2024 provides residents adequate time to participate in the solid fuel burning appliance change out program in order to comply with the regulation without overwhelming the Borough program resources.

The removal and destruction requirements are consistent with the Measure 48 regulations mandating the date certain removal of coal only heaters. With regard to the documentation requirements, since no new coal burning units will be sold, 18 AAC 50.079 (f) permanent inoperability requirements will apply.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 49: Prohibit Use of Coal Burning Heaters

Implementing Jurisdiction(s)

- Town of Telluride and San Miguel County, Colorado

Regulation Weblink(s)

- https://yosemite.epa.gov/R8/R8Sips.nsf/PrintSips/C5D17E5CB9461F8587257EED004BBD82?OpenDocument

Background

The town of Telluride and San Miguel County adopted wood and coal burning emission reduction measures in the 1980's and 1990's, including provisions that:

(1) Require the installation of cleaner burning devices in existing dwellings which have pre-existing solid fuel burning devices;
(2) prohibit solid fuel burning devices in new construction;
(3) ban coal burning; and
(4) limit the total number of fireplaces and woodstoves in the nonattainment area.

These controls were approved by EPA into the Colorado PM_{10} SIP in 1994.[69]

Fairbanks air quality regulations defined coal stoves and coal burning hydronic heaters as Solid Fuel Burning Devices (SFBD). Coal burning stoves and hydronic heaters were not included as Borough-Listed Devices. Unlisted SFBDs could not be installed, did qualify for the Voluntary Replacement and Removal Program, and could not be operated during either a Stage 1 or Stage 2 Alert. Unlisted devices could receive a NOASH certification. Those regulations were Fairbanks requirements addressing the installation and operation of coal burning devices were removed with the passage of the Home Heating Reclamation Act.

Neither the Borough nor the State had regulations that banned coal burning.

EPA commented that they believed "the regulations in Telluride are more stringent than in Fairbanks. Telluride prohibits coal burning all year whereas in Fairbanks an existing coal stove can burn when there is no curtailment which could contribute additional emissions to the airshed, especially during poor conditions when a curtailment may not have been called. We do not agree with the conclusion that the PM_{10} controls are ineligible for consideration for control of $PM_{2.5}$."

Analysis

Another provision is a new subsection to 18 AAC 50.079(f) which requires coal-fired heating devices to be rendered permanently inoperable by December 31, 2024 or before the device is sold, leased, or conveyed as part of an existing building. These restrictions are not limited to curtailment Alerts and therefore directly addresses EPA's concern about contributing additional emissions to the airshed.

The current device inventory estimates that approximately 13,418 wood burning appliances are in the nonattainment area with 2,553 of those appliances estimated to be uncertified. Estimates also show approximately 481 coal fired residential heaters in the nonattainment area for a total of 3,034 appliances that need to be removed. Current funding for the Borough's wood stove change out program show that, including the 2018 Targeted Air Shed grant award, the total projected change outs achievable from 2019 through 2024 are 1,290. The date of 2024 provides residents adequate time to participate in the solid fuel burning appliance change out program in order to comply with the regulation without overwhelming the Borough program resources.

Conclusion

[69] https://www.gpo.gov/fdsys/pkg/FR-2001-06-15/pdf/01-15029.pdf#page=1

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 50: Require Low Sulfur Content Coal

Implementing Jurisdiction(s)

- Puget Sound Clean Air Agency, State of Utah

Regulation Weblink(s)

- https://www.pscleanair.org/DocumentCenter/View/354
- https://yosemite.epa.gov/r8/r8sips.nsf/b2af5baa99cc429287256b5f0054df73/3f2ef963733afd5a87257ef30057c077!OpenDocument

Background

Section 13.04 of the Puget Sound CAA regulations restricts the sulfur content of coal burned in a solid fuel burning device. It allows only the burning of:

Coal with sulfur content less than 1.0% by weight burned in a coal only heater.

Utah regulates the sulfur and ash content of coal for residential use, with the following restrictions:

(1) After July 1, 1987, no person shall sell, distribute, use or make available for use any coal or coal containing fuel for direct space heating in residential solid fuel burning devices and fireplaces which exceeds the following limitations as measured by the American Society for Testing Materials Methods:

(a) 1.0-pound sulfur per million BTU's, and
(b) 12% volatile ash content.

(2) Any person selling coal or coal containing fuel used for direct residential space heating within the State of Utah shall provide written documentation to the coal consumer of the sulfur and volatile ash content of the coal being purchased.

Alaska DEC does not regulate the sulfur content of coal burned in solid fuel burning appliances.

Analysis

The Usibelli Coal Mine is the source of all coal marketed and burned in Fairbanks. Their factsheet[70] indicates the sulfur content of coal from the Healy mine is typically 0.2% with a range of 0.08% - 0.28%. The Healy mine supplies the coal burned in Fairbanks.

Fairbanks has no restriction on the sulfur content of coal marketed and burned within the $PM_{2.5}$ nonattainment area; therefore, the Puget Sound regulation is more restrictive. The sulfur content of Healy coal, however, is well below the 1% threshold mandated by Puget Sound. Therefore, while the Puget Sound regulation is more restrictive, its imposition in Fairbanks will have no effect on coal burning and no emissions benefit.

The Healy fact sheet indicates that the heat content of their coal is 7,560 BTU/lb. Using this value, 132.3 lbs. of coals is needed to produce 1 million BTU. This value combined with the 0.2% content of coal produces 0.26 lbs. of sulfur, which is well below Utah sulfur threshold 1.0 lb. per million BTU. The Healy coal has a 7% average ash content ranging from 4% - 12%, which falls below the 12% volatile ash content Utah threshold.

Conclusion

The Puget Sound and Utah coal content regulations, if adopted by Alaska DEC, would not reduce $PM_{2.5}$ emissions in Fairbanks as the sole source of coal used in the Borough continuously satisfies the Puget Sound and Utah specifications; therefore, this measure is not technologically feasible and not eligible for consideration as BACM.

Measure 51: Ultra-low Sulfur Heating Oil

Implementing Jurisdiction(s)

- Northeast States and Alaska

Regulation Weblink(s)

- https://noraweb.org/wp-content/uploads/2014/11/NEMARegion_ULSDBioChart2014.pdf
- https://www.epa.gov/sites/production/files/2015-04/documents/420f06040.pdf

Background

EPA mandated the production of ultra-low sulfur (15 ppm) Diesel fuel by domestic oil refineries in 2006. Since this mandate addressed only motor vehicle fuel, no reduction in the sulfur content of home heating oil was required. Concerns about the need for reductions in ambient $PM_{2.5}$, SO_2 and regional haze, however led the Northeast states, where most heating oil consumption in the U.S. occurs, to implement laws mirroring the federal Diesel-fuel standard for motor vehicles.

In 2012, New York, which at the time had over a million households using heating oil, was the first northeastern state to set a home heating oil sulfur content standard of 15 ppm.

[70] http://www.usibelli.com/coal/data-sheet

Massachusetts, New Jersey and Vermont followed suit with a less stringent 500 ppm standard in 2014, but are all scheduled to require 15 ppm sulfur levels for heating oil by 2018. In 2016, Maine instituted a 50 ppm standard but will also require 15 ppm levels by 2018.[71] In addition many of the Mid-Atlantic States (including the District of Columbia) have also mandated the use of 15 ppm heating oil by 2018. Overall, 10 states plus selected communities in other states (e.g., Philadelphia) have ultra-low sulfur heating oil requirements.[72]

During the development of the Nonroad Diesel rule, Alaska requested: 1) that June 1, 2010, be the deadline for conversion to 15 ppm sulfur highway Diesel fuel in rural Alaska; 2) that June 1, 2010, be the deadline for conversion of all nonroad, locomotive, and marine (NRLM) diesel fuel to 15 ppm sulfur content in rural Alaska; and 3) that the 15 ppm standard applicable to locomotive and marine diesel fuel produced in, imported into, and distributed or used within rural Alaska be moved up to June 1, 2010 (from the June 2012 nationwide date in the final Nonroad Diesel rule. Because the storage and distribution systems in rural Alaska are not capable of handling more than one grade of fuel, this rule effectively converted home heating fuel to a 15 ppm sulfur limit when it was implemented.

While EPA did not comment on Measure 51, it provided many comments about the state's draft report assessing the cost of producing ultra-low sulfur fuel and requested a further exploration of supply side costs and economies of scale. It also stated the "BACM analysis must start with a transparent and detailed economic analysis of exclusively supplying ultra-low sulfur heating oil to the nonattainment area."

Analysis

EPA mandated the production of ultra-low sulfur Diesel fuel in 2006; the northeast states have mandated the production and use of home heating oil with a 15 ppm sulfur limit. Storage limitations caused most communities in rural Alaska to shift all distillate fuel, including home heating oil, to a 15 ppm sulfur limit when the EPA mandate for ultra-low sulfur Diesel fuel was implemented. The use of 15 ppm home heating oil in an arctic environment has continued since 2010 without problems.

In response to the EPA comments, Alaska expanded the cost report[73] addressing the potential changes in residential home heating expenditures in the Fairbanks $PM_{2.5}$ nonattainment area given hypothetical requirements to switch to different types of heating oil. *Section I* evaluates the fuel cost difference between ultra-low sulfur (ULS) and current heating fuels – high sulfur (HS) No. 1 or No. 2 – and the cost difference between HS No. 1 and HS No. 2. *Section II* assesses how

[71] http://blog.smarttouchenergy.com/ultra-low-sulfur-heating-oil-and-premium-fuels
[72] https://nefi.com/news/docs/heating-oil-standards-chart.pdf
[73] Residential Fuel Expenditure Assessment of a Transition to Ultra-Low Sulfur and High Sulfur No. 1 Heating Oil for the Fairbanks PM-2.5 Serious Nonattainment Area, February 2019, Prepared by The Alaska Department of Environmental Conservation Economist in collaboration with the University of Alaska Fairbanks Master of Science Program in Resource and Applied Economics.

price differences found between fuels would affect household heating expenditures for the typical FNSB household. A copy of the report is included in the Appendix to Chapter 7 of the $PM_{2.5}$ Serious SIP. This information is used in the Step 4 cost effectiveness analysis and is not discussed here.

Conclusion

A significant portion of the U.S., including rural Alaska, is using 15 ppm sulfur content heating oil; a significant portion of the nonattainment area is using No. 1 heating oil, therefore the two scenarios discussed above - shifts from No. 2 to No. 1 and No. 2 to ULS are eligible for consideration as BACM.

Measure 52: Operation and Sale of Small "Pot Burners" Prohibited

Implementing Jurisdiction(s)

- State of Vermont

Regulation Weblink(s)

- http://dec.vermont.gov/sites/dec/files/aqc/laws-regs/documents/AQCD_Regulations_2016_Dec.pdf

Background

Section 5-221 Prohibition of Potentially Polluting Materials in Fuel, subsection 2. Used Oil, contains the following restriction:

> *Effective July 1, 1997, the burning of used oil in small fuel burning equipment described as "pot burners" or "vaporizing" burners shall be prohibited, as shall the retail sale of these burners.*

Neither the Borough nor the State have any regulations restricting the sale of small waste or used oil burners. Borough regulations restrict the operation of waste oil appliances during Stage 1 and Stage 2 Alerts and that create a public nuisance. The State has no additional controls addressing the sale or operation of waste oil appliances.

Analysis

Vermont regulations prohibit both the operation and sale of small waste oil burning devices. Neither Alaska nor the Borough prohibit the sale of small waste oil burning devices. Both agencies have regulations that restrict the operation of waste oil devices during Air Quality Alerts and appliances that create a public nuisance.

Conclusion

Alaska has no regulations governing the sale or operation of waste oil appliances or the use of waste oil used as a heating fuel; therefore, the Vermont measures addressing waste oil are eligible for consideration as BACM. The results of a cost effectiveness analysis of this measure, presented in Step 4, show this measure is economically infeasible.

Measure 53: No Use Sale or Exchange of Used Oil for Fuel, unless it Meets Constituent Property Limits

Implementing Jurisdiction(s)

- State of Vermont

Regulation Weblink(s)

- http://dec.vermont.gov/sites/dec/files/aqc/laws-regs/documents/AQCD_Regulations_2016_Dec.pdf

Background

Section 5-221 Prohibition of Potentially Polluting Materials in Fuel, subsection 2. Used Oil, contains the following restriction:

> *No person shall cause or permit the use, purchase, sale or exchange in trade for use as a fuel in fuel burning equipment in Vermont of any used oil unless:*
>
> *(i) The used oil has constituents and properties within the allowable limits set forth in Table A of this section prior to blending except as provided in subsection (e) below. The Air Pollution Control Officer may prohibit the combustion of used oils containing constituents or properties not listed in Table A of this section if he/she determines that combustion of such used oil may present an unreasonable risk to public health or welfare*

Table A: Used Oil Constituents and Properties (Prior to Blending)

Constituent/Property	***Allowable[1]***
Arsenic	*5 ppm maximum*
Cadmium	*2 ppm maximum*
Chromium	*10 ppm maximum*
Lead	*100 ppm maximum*
Flash Point	*Must be 100 degrees F or more*
Total Halogens	*1000 ppm maximum*
Polychlorinated Biphenyls (PCBs)	*< 2 ppm maximum*
Net Heat of Combustion	*8000 BTU/lb minimum*
1Note: units of parts per million (ppm) are by weight on a water free basis.	

Neither the State nor the Borough have regulations addressing the purchase, sale or exchange of used oil. They also do not have regulations setting limits on waste or used oil properties.

Analysis

Vermont regulations restrict the allowable content and transfer of waste oil used as heating fuel. There are no such restrictions governing waste or used oil as a heating fuel in Fairbanks.

Conclusion

Alaska has no regulations governing the content, use or transfer of waste oil used as a heating fuel; therefore, the Vermont measures addressing waste oil are eligible for consideration as BACM. The results of a cost effectiveness analysis of this measure, presented in Step 4 show this measure is economically infeasible.

Measure 54: Adopt CARB Vehicle Emission Standards

Implementing Jurisdiction(s)

- California Air Resources Board(CARB)

Regulation Weblink(s)

- https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/lev-program/low-emission-vehicle-lev-iii-program

Background

Under Section 177 of the federal Clean Air Act, states that choose to adopt vehicle standards that are more stringent than the federal standards for new vehicles can only adopt California's vehicle emission standards. To date 14 states have opted-in to California's vehicle emissions standards. The most current version of California's Low Emission Vehicle (LEV) III regulations limit greenhouse gases and traditional tailpipe pollutants (HC, CO, NOx and PM). These regulations were modified by California in 2015 to align the California and federal Tier 3 motor vehicle emission standards. The federal Tier 3 rules were finalized in 2014 by the U.S. EPA and reduced tailpipe and evaporative emissions from passenger cars, light-duty trucks, medium-duty passenger vehicles and allowable emissions from heavy-duty vehicles. The California LEV III and federal Tier 3 regulations are consistent from model year 2017 through 2024 for particulate emissions. Starting in 2025, however, the stringency of the LEV III standards will be increased from 3 mg/mi to 1 mg/mi, while the federal Tier 3 standards will remain at 3 mg/mi. Thus, an extremely small reduction in motor vehicle particulate emissions (i.e., 2 mg/mi) will become available in late 2025 and succeeding years.

Analysis

To put 2 mg/mi reduction into perspective, 1 million miles of travel by vehicles meeting the more stringent 2025 – 2028 LEV III particulate emission standards would produce a reduction of 4.4 lbs. Several factors must be considered when assessing the benefit of adopting the LEV III standards, including:

- An analysis of the most recent DMV registrations (April 2018) showed the statewide population of vehicles was 644,312 and a total of 97,600 were registered in Fairbanks. Assuming vehicle ownership is proportional to population, the number of vehicles registered in the nonattainment area is 82,980. Since Alaska would be required to adopt the CARB vehicle standards on a statewide basis, it means 87% of the light duty passenger cars and light-duty trucks sold each year starting in 2025 would be required to meet the more stringent standards without a supporting mandate.

- Assuming wintertime driving travel is roughly 50 miles per vehicle per day (more than twice the value employed in the Fairbanks travel demand model forecasts), it would take 20,000 vehicles to produce 4.4 lb/day reduction in PM emissions. Assuming the 2 mg/mi reduction applied to the entire vehicle fleet, which it does not because the California and federal emission standards for medium/heavy duty vehicles are equivalent through this period, the total reduction potential within the Fairbanks PM nonattainment area would be on the order of 18 lbs per day (in reality less).

The magnitude of the emission reduction potential must be considered in light of the disproportionate impact on the rest of the Alaska vehicle fleet. The statewide adoption of the CARB LEV III emission standards is not cost effective and is not warranted for the Fairbanks $PM_{2.5}$ nonattainment area.

Conclusion

The minimal Fairbanks emissions benefit from a statewide adoption of CARB LEV III emission standards is not cost effective and therefore not eligible for consideration as BACM.

Measure 55: School Bus Retrofits

Implementing Jurisdiction(s)

- Oregon Department of Environmental Quality, Lane Regional Air Protection Agency

Regulation Weblink(s)

- https://www.gpo.gov/fdsys/pkg/FR-2017-11-14/html/2017-24539.htm
- http://www.lrapa.org/DocumentCenter/View/2108

Background

The RACM analysis in the Oakridge, Oregon Moderate $PM_{2.5}$ attainment plan lists Diesel retrofits of school buses as a primary control measure. No specific emissions credit, however is listed for this measure. The 2016 update to the SIP, which EPA proposed for approval, lists implementing diesel retrofits of school buses as a local transportation control measure. It also states:

> *No specific credit was taken for these mobile source programs in the 2015 attainment year emission inventory other than the normal reductions over time included in the MOVES2014a modeling.*

Neither Fairbanks nor the state has a regulation mandating the replacement of Diesel powered school buses. The Fairbanks RACM analysis evaluated *retrofit of diesel fleet (school buses, transit)* as a transportation control measure. The measure was determined to be technologically infeasible as were all measures listed in the category of transportation controls.

Analysis

EPA offers funds for the replacement of Diesel school buses through its Clean Diesel Program. The Diesel Emissions Reduction Act (DERA) provides grants for projects that reduce emissions from existing diesel engines. DERA has funded numerous diesel replacement projects in Alaska. DERA funds are currently being used to replace five diesel generators in four rural communities in Alaska. Other programs have funded diesel garbage truck, power generation and school bus replacement projects. The most recent diesel replacement program conducted in Fairbanks is a joint DEC/DOT&PF project[74] that replaced three heavy duty construction trucks, placed in service by the State of Alaska in 1986. That project was completed in 2010.

Oregon has funded several school bus replacement programs and included them in the Oakridge RACM analysis for the Moderate SIP, which EPA has proposed to approve. That plan, however, takes no specific emissions credit for the program and states that its benefits are included in fleet turn over benefits tracked by EPA's motor vehicle emissions simulator model (MOVES)2014b.

Conclusion

The benefits of the uncredited school bus replacement program are represented in fleet turnover calculations performed by MOVES. Since MOVES is used to represent changes in vehicle fleet emissions in Fairbanks over time, no emissions benefit is available for mandating diesel school bus replacement, therefore this measure is not technologically feasible and not eligible for consideration as BACM.

Measure 56: Road Paving

Implementing Jurisdiction(s)

- Klamath Falls, Oregon

[74] http://dec.alaska.gov/air/anpms/projects-reports/akdot

Regulation Weblink(s)

- http://www.oregon.gov/deq/FilterDocs/KFallsAttPlan2012.pdf

Background

The 2012 $PM_{2.5}$ attainment plan for Klamath Falls includes a road paving control measure. The analysis lists road paving as an existing control measure and states:

> *PM2.5 emissions generated by motor vehicle traffic have been reduced over the years through efforts to pave roads, minimize the use of sanding material, and to control mud and dirt track out from industrial, construction and agricultural operations. Six miles of unpaved road have been paved in the nonattainment area since 2008, resulting in reductions from re-suspended road dust.*

The $PM_{2.5}$ emission reduction benefit of road paving is listed as "minimal".

Alaska does not have an emissions control measure addressing road paving in urban areas. An analysis[75] prepared in 2006 identified road paving as a fugitive dust control measure for implementation in rural communities in Alaska. Fairbanks has no control measures addressing road paving. Unlike many communities in the lower-48, roads in the Fairbanks nonattainment area remain frozen during winter months. The emissions inventory discussion in Step 1 noted that fugitive dust sources of $PM_{2.5}$ are estimated to be negligible under the snow/ice bound conditions reflected in the winter seasonal inventory.

Analysis

The Klamath Falls SIP claims "minimal" $PM_{2.5}$ emission benefit for a fugitive dust control measure. Since fugitive dust emissions in Fairbanks are negligible during the winter, the application of fugitive dust controls with "minimal" benefits in a more moderate climate will produce no benefits.

Conclusion

Fugitive dust control measures will provide no wintertime $PM_{2.5}$ benefit in Fairbanks, therefore it is technologically infeasible and not eligible for consideration as BACM.

Measure 58: Controls on Road Sanding and Salting

Implementing Jurisdiction(s)

- Utah Department of Environmental Quality

[75] *https://dec.alaska.gov/air/anpms/Dust/Dust_docs/DustControl_Report_032006.pdf*

Regulation Weblink(s)

- https://documents.deq.utah.gov/air-quality/pm25-serious-sip/DAQ-2017-011685.pdf
- https://documents.deq.utah.gov/air-quality/pm25-serious-sip/DAQ-2017-011686.pdf
- https://documents.deq.utah.gov/air-quality/pm25-serious-sip/DAQ-2017-011687.pdf

Background

Draft BACM analyses for the Logan, Provo, and Salt Lake Areas in Utah's Serious $PM_{2.5}$ SIP has identified Road Salting & Sanding as a control measure. The analysis prepared for each community included the following finding:

> *R307-307 Road Salting & Sanding: The purpose of this rule is to establish emission control for winter time road salting. This is an existing rule that was part of the PM10 SIP (Section IX, Part A, Page 57) that was approved by EPA on December 6, 1999 (64 FR 68031). A RACT analysis was conducted as part of that SIP. The rule was amended by expanding the applicability to include PM2.5 nonattainment areas as part of the moderate PM2.5 SIP. The actual PM emission reduction is unknown however, past UDAQ studies have indicated that road salt plays a minimal role related to this SIP. Consequently, no further analysis is warranted.*

Fairbanks and Alaska do not have an emissions control measure addressing either road sanding or road salting. Unlike many communities in the lower-48, roads in the Fairbanks nonattainment area remain frozen during winter months. The emissions inventory discussion in Step 1 noted that fugitive dust sources of $PM_{2.5}$ are estimated to be negligible under the snow/ice bound conditions reflected in the winter seasonal inventory.

Analysis

Utah is planning to expand the applicability of the Road Sanding & Salting control measure, a PM_{10} fugitive dust control measure, to the Logan, Provo and Salt Lake $PM_{2.5}$ nonattainment areas. The analysis states that the $PM_{2.5}$ benefit of the measure is "unknown" and no credit is taken for the measure.

Since fugitive dust emissions in Fairbanks are negligible during the winter, the application of fugitive dust controls with "unknown" benefits in Utah's more moderate climate will produce no benefits in Fairbanks.

Conclusion

Fugitive dust control measures will provide no wintertime $PM_{2.5}$ benefit in Fairbanks, therefore this measure is technologically infeasible and not eligible for consideration as BACM.

Measure 60: Vehicle Idling Restrictions

Implementing Jurisdiction(s)

- Many – EPA published a report summarizing state and local idle control programs in 2008.[76]

Regulation Weblink(s)

- None

Background

EPA received "multiple inquiries regarding community interest in controlling emissions from idling" and commented that "these types of controls should be further evaluated in BACM and MSM analyses."

Analysis

The EPA compilation of idle programs listed regulations from 31 different states. A review of the regulations listed in the report found the programs were focused on controlling heavy-duty vehicle activity for a variety of reasons, including: noise, fuel consumption and emissions. Controls addressing light-duty vehicle activity were conspicuously absent. A literature review and related searches could find no SIPs taking particulate emissions credit for anti-idling programs. Texas for example has an extensive anti-idling program focused on reducing NOx emissions. Another consideration is that a survey of heavy-duty truck operators in Fairbanks conducted by DEC staff found that none kept their vehicles idling for extended periods (e.g., overnight) as it was cheaper from both a fuel consumption and a maintenance perspective to keep their vehicles stored indoors when not in use.

A complicating factor when considering the benefits of anti-idling programs in Alaska is that emission control system performance deteriorates at cold temperatures when engines are turned off and catalysts cool down. A study conducted by Sierra Research[77] found there was little or no air quality benefit from turning off a warmed-up vehicle if it was going to be started soon thereafter. For example, they found that turning-off a warmed vehicle during a short (60 minute or less) shopping errand provides no CO air quality benefit. The emissions from a vehicle left running were roughly comparable to a vehicle that was turned off and re-started at the end of the errand. While that study did not address tradeoffs in particulate emission reductions it demonstrated that lower-48 control program benefits do not necessarily apply in Alaska and that

[76] EPA420-B-06-004 "Compilation of State, County and Local Anti-Idling Regulations", April 2008

[77] Di Genova, F., et al, "Fairbanks Cold Temperature Vehicle Testing: Warmup Idle, Between-trip Idle, and Plug-in," prepared for Alaska Department of Environmental Conservation by Sierra Research, January 2002.

careful consideration of cold temperatures on emission control system performance needs to be considered in the evaluation of anti-idling programs. Sierra conducted a test program[78] for DEC that measured light-duty vehicle $PM_{2.5}$ emissions under alternative temperatures and modes of operation. The data and analysis conducted in that study, however, have not been used to assess the potential benefits of an anti-idling program on $PM_{2.5}$ emissions during winter operating conditions in Fairbanks.

Given the challenges of assessing the benefits of an anti-idling control program in Alaska, the finding that it produced no CO emission benefit for light-duty gasoline powered vehicles and the finding that no SIPs have taken credit for particulate emission reductions leads to the conclusion that there is no evidence this measure produces a particulate emissions benefit.

Conclusion

There is no evidence this program provides a particulate emissions reduction under cold temperature conditions in Fairbanks, therefore it is not technologically feasible and not eligible for consideration as BACM.

Measure 61: Fuel Oil Boiler Upgrade – Burner Replacement/Repair

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- None

Background

EPA commented that the benefits of fuel oil boiler maintenance should be investigated as a control measure.

Analysis

Despite the finding that no benefits for this type of control program have been found in SIPs, information collected for the emissions inventory found that over 60% of the homes in the nonattainment area are heated with fuel oil and most are equipped with fuel oil boilers. Discussions with local vendors and repair technicians were conducted to determine the magnitude of potential fuel consumption benefits from cleaning and replacing burners. It was found that the benefits depend on the age of the boiler and level of regular maintenance.

[78] DiGenova, F. et al, "Characterizing Vehicular Contributions to PM2.5 in Fairbanks, Alaska, Volume 1: Dynamometer-Based Emissions Measurements, Vehicle Keep-warm Activities and MOVES Analysis, December 2012 (Volumes 1 – 4)

Brookhaven National Laboratory conducted an extensive evaluation of [79] the effects of maintenance on fuel consumption and emissions of fuel oil boilers and found significant benefits; little information however was found about the benefits of burner replacement. Despite this limitation and the lack of detailed information about the age of fuel oil boilers and related maintenance intervals, it is clear that a program mandating regular maintenance has the potential reduce fuel use and emissions from fuel oil boilers.

Conclusion

Test measurements have demonstrated that improved fuel oil boiler maintenance reduces fuel consumption and emissions, therefore this measure is technologically feasible. This finding addresses EPA's comments. The results of a cost effectiveness analysis of this measure, presented in Step 4, show this measure is economically infeasible.

Measure 62: Fuel Oil Boiler Upgrade – Replacement

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- None

Background

EPA commented that the benefits fuel oil boiler upgrades should be investigated as a control measure.

Analysis

Despite the finding that no benefits for this type of control program have been found in SIPs, information collected for the emissions inventory found that over 60% of the homes in the nonattainment area are heated with fuel oil and most are equipped with fuel oil boilers. Discussions with local vendors and repair technicians were conducted to determine the magnitude of potential fuel consumption benefits from upgrading/replacing fuel oil boilers. It was found that the benefits depend on the age of the boiler and level of regular maintenance.

[79] Roger J. McDonald, Brookhaven National Laboratory, "Evaluation of Gas, Oil and Wood Pellet Fueled Residential Heating System Emissions Characteristics" Energy Sciences and Technology Department, December 2009

Brookhaven National Laboratory conducted an extensive evaluation[80] of emissions from a variety of fuel oil boilers and furnaces (e.g., conventional, condensing, etc.) using fuels of varying sulfur levels and found that technology has a significant benefit. Detailed information about the age and maintenance intervals of the existing stock of fuel oil boilers, however is required to assess the benefits of a program mandating upgrades/replacement. While this information is not available for homes located in the nonattainment area, the Brookhaven report indicates that newer technologies reduce emissions.

Conclusion

Test measurements have demonstrated that more efficient fuel oil boilers reduce emissions, therefore this measure is technologically feasible. This finding addresses EPA's comments. The results of a cost effectiveness analysis of this measure, presented in Step 4, show this measure is economically infeasible..

Measure 63: Require Electrostatic Precipitators

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- None

Background

ESPs are pollution control devices that use electrical forces to remove fine particulate matter (PM) from exhaust streams. PM collection in an ESP occurs in three steps: suspended particles are given an electrical charge; the charged particles migrate to a collecting electrode; and the collected PM is dislodged or cleaned from the collecting electrode. ESP technology has been available for over a century and successfully employed on numerous industrial applications in the U.S., and throughout the world, with typical PM control efficiencies of 90% – 99%. Central to achieving the aforementioned performance is site specific design, continuous monitoring, and periodic maintenance; i.e. ESPs are not one size fits all, and are not plug and play.

Other countries, most notably European countries, have implemented ESPs on residential wood stoves. The technology transfer from the industrial sector to the residential sector required each country to address key issues not inherent in the technology itself; e.g. site specific design, continuous monitoring, and periodic maintenance. A review of regulations from Zurich, Switzerland, found that ESPs may be retrofitted on handcrafted wood stoves to meet standards in cases where laboratory certification is not practical. Zurich also encourages the use of ESPs in

[80] Roger J. McDonald, Brookhaven National Laboratory, "Evaluation of Gas, Oil and Wood Pellet Fueled Residential Heating System Emissions Characteristics" Energy Sciences and Technology Department, December 2009

general to reduce emissions, but does not provide any additional regulatory incentive to use an ESP. Notable regulations that address monitoring and maintenance requirements include:

- Annual inspections to verify proper device operation and use of clean dry fuel;
- Annual chimney sweep by certified professional;
- All hydronic heating systems subject to emission measurements every 2 years;
- Only dry and untreated wood may be burned. In case of doubt, an ash sample is collected, analyzed by a laboratory, and judged by the authorities; and,
- Minimum of 60% control efficiency for retrofit control devices, such as ESPs.

No SIPs or EPA guidance documents were identified requiring the installation of an ESP or any retrofit control device on residential wood stoves.

Analysis

A review of applicable SIPs and EPA guidance documents could find no requirements for retrofitting wood stoves with ESPs. While ESPs appear to offer a potential emission reductions, there are several obstacles to successful implementation. The lack of regulatory framework and regulatory authority to certify and guarantee long term performance is one obstacle, specifically:

- The EPA does not have any certification process for retrofit control devices on wood stoves; and,
- The regulatory framework at the local, state, and federal level lack the necessary language to exclude devices with unproven performance (e.g. homemade devices).

No other jurisdiction in the United States has implemented a monitoring and maintenance plan at a residential level that guarantees operation of a retrofit emission control device which create the following obstacles:

- ESPs require professional installation: there are a lack of trained professionals and currently no way to verify installation;
- ESPs require periodic chimney cleanings: currently there is no way to verify cleaning; and,
- ESPs require periodic maintenance: there are a lack of trained professionals and currently no way to verify maintenance.

The implementation strategy, i.e. incentive for residents to purchase and install ESPs, is not clearly identified which is another obstacle. Community members view ESP installation in lieu of burn bans as the incentive to install; however that strategy could lead to worse air quality conditions if ESP performance deteriorates over time, and there are legal issues regarding backsliding with the Fairbanks Moderate State Implementation Plan (SIP). Another implementation strategy would be a requirement to install ESPs on certain devices (e.g. devices that are exempt from burn bans), which would achieve the highest air quality benefit but would likely be viewed as regulatory overreach by the community.

Conclusion

Without a federal certification process, the lack of regulatory framework at the local and state level, and the lack of an implementation strategy, the timing required to adopt this measure is well beyond the June 9, 2021 requirement for BACM. This measure is not technically feasible to implement by June of 2021 and is dismissed from the BACM analysis.

Measure 64: Weatherization and Energy Efficiency

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- None

Background

EPA commented that weatherization and heat retention programs should be evaluated as a control measure. They suggested evaluating the benefits of energy audits and increased insulation. The survey of SIPs did not identify any control measures mandating weatherization and claiming related emission reduction benefits.

Analysis

Given the high cost of home heating, Alaska has many programs for improving home heating efficiency. The Alaska Housing Finance Corporation offers a variety of programs that offer information (e.g., air sealing, appliance efficiency, insulation, home maintenance, ventilation, etc.) and financial incentives (home energy loans, rebates and low income weatherization, etc.) to improve home heating efficiency. The Alaska Energy Authority also provides a wide range of programs to improve heating efficiency. Another source of information for constructing new homes is the IECC Compliance Guide for Homes in Alaska, which provide guidance on air sealing, fenestration, insulation and ducts. All of these programs and codes lead to home heating efficiency improvements, which reduce emissions.

All of the programs mentioned are voluntary programs, and the leap from voluntary to mandatory requires significant work. An applicability mechanism needs to be identified that requires when a home's efficiency would be reviewed, such as: home sale, application for an exemption, or purchase of a SFBA. Then a threshold for energy efficiency needs to be determined and the required actions need to be outlined. While recommendation 16 from the Air Quality Stakeholders group identifies a possible applicability mechanism with the requirement for a home energy audit at the time of home sale, the Stakeholders Group could not agree on a threshold or required actions.

Conclusion

Programs which stimulate home heating system replacement produce heating efficiency improvements and credit for both the efficiency improvement and emissions reductions are accounted for in the control measure analysis for the SIP. Energy audits, increased insulation and related weatherization measures are also being implemented on a voluntary basis, so they are clearly technologically feasible. However, the leap from voluntary measure to mandated measure requires significant work. The literature review did not provide any model rules, and there are significant gaps to address including applicability, thresholds, requirements, and legal authority. The timing required to adopt this measure is well beyond the June 9, 2021 requirement for BACM. This measure is not technically feasible to implement by June of 2021 and is dismissed from the BACM analysis.

Measure 65: Emissions Crossing Property Lines

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- None

Background

Prior to the Proposition 4 vote on the Home Heating Reclamation Act, Fairbanks Code included a restriction on visible emissions crossing property lines. That requirement, however, was removed from Borough Code.

Analysis

The fact that this requirement was previously in place, clearly demonstrates that it is technologically feasible. As noted in the introduction, a new regulation 18 AAC 50.075(f)(2) requires that solid fuel fired heating devices shall be operated so that visible emissions do not cross property lines.

Conclusion

The adoption of the referenced state regulation is sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 66: Curtailment Threshold

Implementing Jurisdiction(s)

- San Joaquin Valley APCD

- Sacramento APCD

Regulation Weblink(s)

- http://www.valleyair.org/pmplans/documents/2018/pm-plan-adopted/2018-Plan-for-the-1997-2006-and-2012-PM2.5-Standards.pdf
- http://www.airquality.org/ProgramCoordination/Documents/Rule421%20Presentation%20092409%20Item5.pdf

Background

In a June 5, 2019 Federal Register Notice[81], EPA finalized its approval of "revisions to the Alaska State Implementation Plan (SIP) that were submitted by the Alaska Department of Environmental Conservation (ADEC). These revisions update and strengthen ADEC's regulation of residential wood smoke emissions, especially the curtailment program as it applies to the Fairbanks fine particulate matter nonattainment area."

Analysis

The current thresholds adopted by the State and approved by EPA are 25 and 35 µg/m^3 for Stage 1 and Stage 2 curtailment respectively. As noted in Measure 40, more stringent curtailment thresholds are in place in San Joaquin Valley and Sacramento. Recognizing the need for additional emission reductions and the lower thresholds found in other control programs, Alaska has modified it Emergency Episode Plan and lowered the Stage 1 and Stage 2 curtailment thresholds to 20 and 30 µg/m^3 respectively.

Conclusion

The adoption of Emergency Episode Plan requirements are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 67: Coffee Roasters

Implementing Jurisdiction(s)

- Colorado

Regulation Weblink(s)

- https://www.colorado.gov/pacific/sites/default/files/AP_Coffee-Roasting.pdf

[81] Federal Register / Vol. 84, No. 56 / Friday, March 22, 2019

Background

Alaska Department of Environmental Conservation (ADEC) regulation 18 AAC 50.055 imposes emission limits on industrial processes and fuel-burning equipment that are applicable to coffee roasting operations in the Fairbanks North Star Borough. This regulation limits the opacity of visible emissions from fuel-burning equipment to no more 20 percent averaged over any six consecutive minutes.[82] Neither ADEC nor the Borough have adopted regulations specific to emissions from coffee roasting operations.

Though not having regulations specific to the reduction of emissions from coffee roasters, a number of jurisdictions outside of Alaska do have permit requirements for facilities from which emissions exceed a specific threshold, and coffee roasting facilities are not exempted from these requirements.

A summary of the State Implementation Plans for Colorado,[83] as developed by the Regional Air Quality Management Council[84] – which was established in 1989 to serve as the lead air quality planning agency for the Denver metropolitan area – indicates that in 1987, Denver was designated as a "Group I" nonattainment area for PM_{10} and then designated as a moderate attainment area in 1990 with regard to the 24-hour PM_{10} standards. Among the control measures contained within the 1993 PM_{10} Attainment SIP was one that stated that:

All existing permits and applicable provisions of AQRs[85] No. 1 and 3 enforced for both minor and major industrial sources of PM_{10}, NO_x and SO_2.

The Colorado Department of Public Health and Environment (CDPHE) currently enforces Regulation Number 3: Stationary Source Permitting and Air Pollutant Emission Notice Requirements,[86] which requires that:

For criteria pollutants, Air Pollutant Emission Notices are required for: each individual emission point in a nonattainment area with uncontrolled actual emissions of one ton per year or more of any individual criteria pollutant (pollutants are not summed) for which the area is nonattainment; each individual emission point in an attainment or attainment/maintenance area with uncontrolled actual emissions of two tons per year or more of any individual criteria pollutant (pollutants are not summed)

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[82] http://dec.alaska.gov/media/1038/18-aac-50.pdf, accessed June 20, 2018.
[83] https://raqc.egnyte.com/dl/SMXBbYwYdO/StateImplementationPlanSummaries2018.pdf_; updated January 2018, accessed April 11. 2018.
[84] http://raqc.org/
[85] Air Quality Regulation
[86] Colorado Department of Public Health and Environment, Air Quality Control Commission, Regulation Number 3: Stationary Source Permitting and Air Pollutant Emission Notice Requirements, available at https://www.colorado.gov/pacific/sites/default/files/5-CCR-1001-5.pdf, accessed April 11, 2018.

Also listed within Regulation Number 3 is a list of facilities for which exemption from Regulation Number 3 could be granted, but coffee roasting facilities are not included within that list. In fact, in 2014 the CDPHE's Air Pollution Control Division released a memo entitled "An Overview of Colorado Air Regulations for Coffee Roasting",[87] which lists these same limits for exemptions, implying that the requirement has been maintained despite Colorado having achieved attainment status for PM_{10}. Lastly, direct communication with the Air Pollution Control Division of the Colorado Department of Public Health confirmed that no regulation has ever been developed specifically for coffee roasting facilities within Colorado and that any permitting requirements for coffee roasting facilities within Colorado has just been part of the overall permitting or New Source Review requirements.[88]

The requirements for coffee roasting operations exceeding either of the emission thresholds are the maintenance of visible emissions at opacity levels of 20% of less, and the use of a cyclone capable of reducing uncontrolled particulate matter emissions by at least 70%.[89]
In addition to Colorado, other jurisdictions have indicated a requirement for coffee roasters to apply for permits related to their operations:

- Oregon requires permits for facilities that process thirty or more tons of roasted coffee per year.[90]
- The San Diego County Air Pollution Control District Rules require a permit for "any coffee roaster with a maximum capacity above 11 pounds"[91] and guidance specific to coffee roasting operations states that emissions from coffee roasting "are typically controlled using a combination of a cyclone and either an afterburner or wet-scrubber."[92]
- Washington Administrative Code 173-401-530 defines the threshold for insignificant emissions, and thus permitting requirements, as 0.75 tons per year of PM_{10}[93] and does not exempt coffee roasters.
- The Rules of the South Coast Air Quality Management District (SCAQMD) mention coffee roasting facilities only as facilities for which no permits are required unless a facility is subject to Regulation IX (Standards for Performance of New Stationary

[87] https://www.colorado.gov/pacific/sites/default/files/AP_Coffee-Roasting.pdf
[88] Communication with Casey Houlden, Air Pollution Control Division, Colorado Department of Public Health, April 16, 2018; Communication with Leah Martland, Air Pollution Control Division, Colorado Department of Public Health, April 16, 2018
[89] An Overview of Colorado Air Regulations for: Coffee Roasting, Colorado DPHE Air Pollution Control Division, Small Business Assistance Program, 8/2014, p. 7, https://www.colorado.gov/pacific/sites/default/files/AP_Coffee-Roasting.pdf (accessed on June 14, 2018)
[90] http://www.oregon.gov/deq/FilterPermitsDocs/aqgp116.pdf
[91] https://www.arb.ca.gov/drdb/sd/curhtml/R11.pdf
[92] https://www.sandiegocounty.gov/content/sdc/apcd/en/engineering/Permits/Engineering_Phase_2/Coffee_Roasters.html
[93] http://apps.leg.wa.gov/wac/default.aspx?cite=173-401-530

Sources), or Regulation X (National Emissions Standards for Hazardous Air Pollutants), both of which are general in nature and not related specifically to coffee roasting facilities.[94,95]

- The Sacramento Metropolitan Air Quality Management District has also not adopted any regulations specific to coffee roasting facilities,[96] but does maintain a specific webpage to assist coffee roasting facilities with the acquisition of a permit for new installations or modifications of facilities.[97]
- The Puget Sound Clean Air Agency does not have any regulations specific to coffee roasting facilities,[98] and coffee roasting facilities are not listed in Regulation 1-9,[99] which sets requirements for specific sources.[100]
- The New York State Department of Environmental Conservation does not have any apparent regulations specific to coffee roasters,[101] and the list of SIP-approved measures applicable in New York does not include any specific to coffee roasting operations,[102] implying that such operations in New York State are subject only to permit requirements.
- The Idaho Department of Environmental Quality, in rule 58.01.01, Rules for Control of Air Pollution in Idaho, makes no specific mention of coffee roasting facilities.[103]
- The Bay Area Air Quality Management District, in a manner similar to the SCAQMD, states that coffee roasting facilities "with a roasting capacity of less than 15 pounds of beans or nuts per hour" are "exempt from the requirements of Sections 2-1-301 and 302," which are the permitting standards for construction and operation of facilities.[104]

To ensure that coffee roasters are properly represented in the emissions inventory, ADEC staff identified batch roasting facilities located within the nonattainment area and conducted a telephone survey to collect information on capacity (lbs/year), utilization, existing controls, etc. Due to concerns about regulation and competition the responses were limited and provided no insight into their operations. One respondent, however noted their facility employed a thermal oxidizer to control emissions.

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[94] SCAQMD, 2017, Rules. Available at https://www.epa.gov/sites/production/files/2018-01/documents/south_coast_district_rules_compilation_dec_2017.pdf, accessed May 2, 2018.
[95] http://www.aqmd.gov/home/rules-compliance/rules/scaqmd-rule-book/regulations-ix-and-x
[96] https://www.epa.gov/sites/production/files/2018-01/documents/sacramento_metropolitan_air_quality_management_district_aqmd_rules_compilation_dec_2017.pdf
[97] http://www.airquality.org/businesses/permits-registration-programs/permit-applications-recordkeeping-advisories/coffee-bean-roasting-operations
[98] http://www.pscleanair.org/219/PSCAA-Regulations
[99] http://www.pscleanair.org/DocumentCenter/View/342/1-9-PDF
[100] http://www.pscleanair.org/101/Permits-Registration; http://www.pscleanair.org/181/Title-V-Operating-Permits
[101] http://www.dec.ny.gov/regulations/regulations.html
[102] https://www.epa.gov/sips-ny/epa-approved-statutes-and-regulations-new-york-sip
[103] https://adminrules.idaho.gov/rules/current/58/580101.pdf
[104] https://www.epa.gov/sites/production/files/2018-01/documents/san_francisco_bay_area_air_quality_management_district_baaqmd_rules_compilation.pdf

Analysis

The permit requirement of the San Diego County Air Pollution Control District for use of a cyclone in combination with an afterburner or wet scrubber appears to constitute the most stringent emission control requirement on emissions from coffee roasting operations. The use of a cyclone with an afterburner or wet scrubber will typically result in visible emissions from coffee roasting operations that are substantially less than 20 percent opacity. Although this permit requirement is not contained in an approved $PM_{2.5}$ SIP, the inclusion of this control technology as the standard for control expected in a permit application makes this technology eligible for consideration as BACM.

The finding that a thermal oxidizer is currently used to control emissions from a facility located within the nonattainment area demonstrates that this measure is technologically feasible.
As noted in the introduction, a new regulation 18 AAC 50.078(d) requires coffee roasters within an area identified in 18 AAC 50.015(b)(3) to install a pollution control device on any unit that emits 24 lbs or more of particulate matter within a 12-month period. The requirement for installation of control equipment on coffee roasters will be 1 year from the effective date of regulation

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure 68: Charbroilers

Implementing Jurisdiction(s)

- Bay Area Air Quality Management District (California)
- South Coast Air Quality Management District (California)
- San Joaquin Valley Unified Air Pollution Control District (California)

Regulation Weblink(s)

- http://www.baaqmd.gov/~/media/dotgov/files/rules/reg-6-rule-2-commercial-cooking-equipment/documents/rg0602.pdf?la=en;
- http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1138.pdf?sfvrsn=4,
- http://www.valleyair.org/rules/currntrules/r4692.pdf

Background

Alaska Department of Environmental Conservation (ADEC) regulation 18 AAC 50.055 imposes emission limits on industrial processes and fuel-burning equipment that are applicable to charbroiling operations in the Fairbanks North Star Borough. This regulation limits the opacity

of visible emissions from fuel-burning equipment to no more 20 percent averaged over any six consecutive minutes. Neither ADEC nor the Borough have adopted regulations specific to emissions from charbroiling operations.

Charbroiling – either chain-driven or under-fire - is a method of flame-cooking meat that is popular in restaurants or other commercial cooking operation where speed and production volume in the preparation of cooked meats are priorities. In chain-driven charbroiling, meat is carried on a slotted, conveyorized grill between two sets of gaseous fuel burners, one above the grill and one below.[105] In under-fire charbroiling, a stationary slotted grill holds the meat while it is exposed to radiant heating from gaseous fuel burners located below the grill. A few air quality regulatory agencies have adopted emission control requirements to reduce $PM_{2.5}$ emissions from charbroiler operations.

The Bay Area Air Quality Management District (California) adopted Regulation 6, Rule 2 (Commercial Cooking Equipment) in 2007 to reduce PM emissions from both chain-driven and under-fire charbroiling sources.[106] The rule requires:

- for chain-driven charbroilers with a throughput of at least 400 pounds of beef per week, the use of a catalytic oxidizer that reduced PM_{10} emissions to no more than 1.3 pounds per 1000 pounds of beef cooked per manufacturer's certification, or any other control device that limits the PM_{10} emissions to 0.74 pounds per 1000 pounds of beef cooked as determined by onsite source testing; and
- for under-fire charbroilers processing more than 800 pounds per week on more than 10 square feet of cooking area, the use of a control device certified to limit PM_{10} emissions to no more than 1 pound of PM_{10} per 1,000 pounds of cooked beef.

The South Coast Air Quality Management District adopted Rule 1138 (Control of Emissions from Restaurant Operations) in 1997 to control emissions from chain-driven charbroilers only.[107] The Rule requires the use of catalytic oxidizers to control PM_{10} emissions from chain-driven charbroilers, but does not set a specific emission limit. Charbroilers in operation as of November 14, 1997 are allowed a ten year delay in compliance. All new or retrofitted charbroiler systems must submit source test data to the AQMD upon initial startup with catalytic oxidizers installed. Chain-driven charbroilers permitted with a meat processing limit of less than 875 pounds of meat per week, as documented by weekly records maintained for five years of meat purchased and

[105] South Coast Air Quality Management District, Preliminary Draft Staff Report: Proposed Amended Rule 1138 – Control of Emissions from Restaurant Operations, 2009, available at http://www.aqmd.gov/docs/default-source/rule-book/support-documents/rule-1138/par1138pdsr.pdf, accessed on April 12, 2018.
[106] Bay Area Air Quality Management District, Regulation 6 – Particulate Matter Rule 2 Commercial Cooking Equipment, http://www.baaqmd.gov/~/media/dotgov/files/rules/reg-6-rule-2-commercial-cooking-equipment/documents/rg0602.pdf?la=en, accessed on June 21, 2018.
[107] http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1138.pdf?sfvrsn=4, accessed on June 21, 2018.

cooked, and demonstrating through source testing that PM_{10} emissions are less than one pound per day, are exempt from the requirement to use a catalytic oxidizer.

The San Joaquin Valley Unified Air Pollution Control District last amended Rule 4692 (Commercial Charbroiling) in 2009 to control emissions from chain-driven charbroilers only. [108] The Rule requires charbroilers processing more than 875 pounds of meat per week to be equipped and operated with a catalytic oxidizer certified by South Coast AQMD to have a control efficiency of at least 83% for PM_{10} emissions. Charbroilers processing less than 875 pounds of meat per week are exempt from the requirement to install catalytic oxidizers if weekly records of meat purchased and cooked are maintained for five years and source testing demonstrates the maximum meat processing rates at which PM_{10} emissions are maintained at less than one pound per day. Charbroilers processing less than 400 pounds of meat per week, or less than 10,800 pounds in the most recent 12 month period and less than 875 pounds in any single week, are exempt from the requirements to install catalytic converters and from the requirements for source testing.

The Utah Department of Environmental Quality last amended R307-303 (Commercial Cooking) in 2018 to control $PM_{2.5}$ emissions from chain-driven charbroilers in $PM_{2.5}$ nonattainment counties.[109] This regulation requires the use of catalytic oxidizers on all chain-driven charbroilers in these jurisdictions, regardless of meat processing capacity. The regulation also requires that the opacity of exhaust from catalytic oxidizers serving chain-driven charbroilers not exceed 20% using U.S. EPA Method 9.

Analysis

The Utah DEQ regulation requires catalytic oxidizers on all chain-driven charbroilers in specified counties, but does not require the catalytic oxidizers to be certified to a specific emission limit as required by the Bay Area AQMD or the San Joaquin Valley UAPCD. Catalytic oxidizers satisfying the Bay Area AQMD mass emission rate or the San Joaquin Valley UAPCD control efficiency should operate at visible emission opacities considerably below the Utah DEC 20% limit. These controls are technologically feasible.

As noted in the introduction, a new regulation 18 AAC 50.078(c) requires charbroilers to submit information on their location, operation type (chain driven versus underfire), number of operations, fuel used, # of lbs of meat cooked/week, etc. This information is required to develop charbroiler regulations.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required. Once responses are received, DEC will review and analyze the results and will determine in future SIP updates whether they need to be addressed.

[108] http://www.valleyair.org/rules/currntrules/r4692.pdf, accessed on June 21, 2018.
[109] https://rules.utah.gov/publicat/code/r307/r307-303.htm, accessed on June 21, 2018.

Measure 69: Incinerators

Implementing Jurisdiction(s)

- South Coast AQMD
- Washington State
- Colorado
- South Coast AQMD
- New York State

Regulation Weblink(s)

- See listed footnotes below

Background

The Alaska Department of Environmental Conservation, under the Alaska Administrative Code 18.AAC.50.050 – Incinerator Emission Standards, PM emissions are restricted to the levels, which vary with the size of the facility, that are shown in the following table:[110]

Incinerator	Particulate Matter Standard
Rated capacity less than 1,000 pounds per hour	No limit
Rated capacity greater than or equal to 1,000 but less than 2,000 pounds per hour	0.15 grains per cubic foot of exhaust gas corrected to 12 percent carbon dioxide and standard conditions, averaged over three hours
Rated capacity greater than or equal to 2,000 pounds per hour	0.08 grains per cubic foot of exhaust gas corrected to 12 percent carbon dioxide and standard conditions, averaged over three hours
An incinerator that burns waste containing more than 10 percent wastewater treatment plant sludge by dry weight from a municipal wastewater treatment plant that serves 10,000 or more persons	0.65 grams per kilogram of dry sludge input

These restrictions were most recently amended in 2008.

[110] Alaska Administrative Code Title 18, Environmental Conservation, Chapter 50 Air Quality Control, available at https://www.epa.gov/sites/production/files/2017-10/documents/sip-ak-approved-regulations-18-aac-50.pdf, accessed April 16, 2018

Under a regulation last amended in 1992, San Joaquin Valley APCD Rule 4203 (Particulate Matter Emissions From Incineration of Combustible Refuse) restricts particulate matter emissions from refuse incinerators to less than 0.10 pounds per 100 pounds of refuse burned. [111] The rule also limits particulate emissions to 0.10 grains per dry standard cubic foot (gr/dscf) of exhaust gas corrected to 12% CO_2 for incinerators having burn rates in excess of 100 pounds per hour, and to 0.30 gr/dscf corrected to 12% CO_2 for incinerators having burn rates less than or equal to 100 pounds per hour.

South Coast AQMD Rule 473 (Disposal of Solid and Liquid Wastes) imposes similar particulate matter emission limits on incinerators.[112] For incinerators with design combustion rates greater than 110 pounds per hour, the emission limit is 0.1 gr/dscf corrected to 12% CO_2. For incinerators with design combustion rates less than or equal to 110 pounds per hour, the emission limit is 0.3 gr/dscf corrected to 12% CO_2.

The Washington Department of Ecology Rule 173-434-130 (Solid Waste Incinerator Facilities) requires that incinerators capable of burning 250 or more tons of solid waste per day emit no more than 0.020 gr/dscf corrected to 7% O_2, and that incinerators capable of burning more than 12 tons but less than 250 tons of solid waste per day emit no more than 0.030 gr/dscf corrected to 7% O_2. In addition, Rule 173-434-160 requires the combustion zone temperature not fall below 1600 degrees F, or not average less than 1800 degrees F over any fifteen-minute period, or that the combustion air leaving the chamber must maintain an oxygen concentration of at least 3% on a wet basis.[113]

Restrictions similar to those in Alaska have been adopted by the Colorado Department of Public Health & Environment, where - in areas designated as non-attainment or attainment/maintenance for particulate matter - no owner or operator of an incinerator is allowed to cause or permit particulate matter emissions of more than 0.10 gr/dscf corrected to 12 % CO_2. In areas designated as attainment for particulate matter, the emission limit if 0.15 gr/dscf corrected to 12 % CO_2.[114]

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[111] San Joaquin Valley Unified Air Pollution Control District, Rule 4203 Particulate Matter Emissions from Incineration of Combustible Refuse (Adopted May 21, 1992, Amended December 17, 1992), available at http://www.valleyair.org/rules/currntrules/r4203.pdf, accessed April 12, 2018

[112] http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-473.pdf?sfvrsn=4, accessed on June 25, 2018.

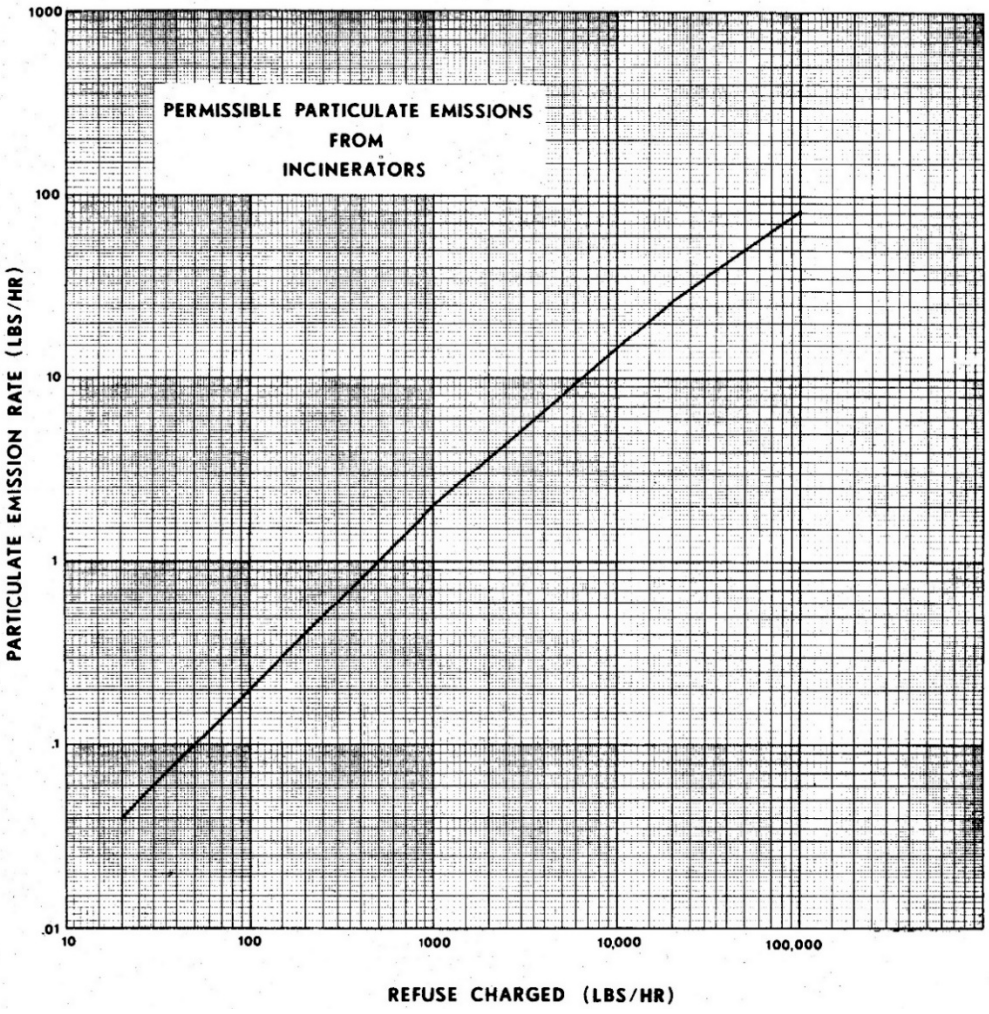
[113] Washington State Legislature, Chapter 173-434, Solid Waste Incinerator Facilities, available at http://apps.leg.wa.gov/wac/default.aspx?cite=173-434&full=true, accessed April 12, 2018

[114] Colorado Department of Public Health and Environment, Air Quality Control Commission, Regulation No. 1 Emission Control for Particulate Matter, Smoke, Carbon Monoxide, and Sulfur Oxides 5 CCR1001-3, 2007, available at https://www.colorado.gov/pacific/sites/default/files/5-CCR-1001-3.pdf, accessed April 12, 2018

San Diego County Air Pollution Control District Rule 53 limits combustion particulate emissions from incinerators to 0.10 gr/dscf corrected to 12% CO_2, except for those with a rated capacity of 100 pounds per hour or less, which are limited to 0.30 gr/dscf corrected to 12% CO_2.[115]

New York State Department of Environmental Conservation Codes, Rules and Regulations Chapter III, Part 219 (Incinerators), Subpart 2.2 (Emission Limitations) limits particulate matter emissions from incinerators statewide to 0.010 gr/dscf corrected to 7% O_2. Subpart 6.2 (Existing Incinerators – New York City, Nassau and Westchester Counties; Particulate Emissions) limits particulate emissions from existing incinerators to values displayed in the following figure:

FIGURE 1



[115] San Diego County Air Pollution Control District, Rule 1. Title, available at https://www.epa.gov/sites/production/files/2018-01/documents/san_diego_county_air_pollution_control_district_apcd_rules_compilation_dec_2017.pdf, accessed April 16, 2018

New York State DEC regulations also limit particulate emissions for existing incinerators in other portions of the state to values displayed in a different, less restrictive figure. Other sections of Part 219 place restrictions on the O_2 and CO_2 exhaust content and minimum combustion temperatures, among other requirements.[116]

Analysis

The regulatory emission limitations of particulate matter from incinerators enforced by San Joaquin Valley APCD, South Coast AQMD, San Diego County APCD, Washington State DEQ, Colorado DPHE, and New York State DEC are all more restrictive than those applicable to incinerators in Fairbanks, and are therefore technologically feasible.

As noted in the introduction, a new regulation 18 AAC 50.078(c) requires incinerators to submit information on location, type (medical, liquid, solid, etc.), process, fuel, throughput, hours of operation, etc. This information is required to develop more stringent incinerator regulations.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required. Once responses are received, DEC will review and analyze the results and will determine in future SIP updates whether they need to be addressed.

Measure 70: Used Oil Burners

Implementing Jurisdiction(s)

- State of Vermont

Regulation Weblink(s)

- https://dec.vermont.gov/sites/dec/files/aqc/laws-regs/documents/AQCD%20Regulations%20ADOPTED_Dec132018.pdf

Background

Measures 52 and 53 addressed controls mandated by the State of Vermont prohibiting the burning of used fuel oil in small "pot burners" or vaporizing burners. Both measures were

[116] Westlaw Compilation of New York Codes, Rules, and Regulations, Subpart 219-2 Municipal and Private Solid Waste Incineration Facilities, available at https://govt.westlaw.com/nycrr/Browse/Home/NewYork/NewYorkCodesRulesandRegulations?guid=Ib66e7530b5a011dda0a4e17826ebc834&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)&bhcp=1, accessed April 12, 2018.

determined to be technologically feasible. In the process of considering a set of regulations governing the accumulation, distribution and burning of used oil, it was determined that little information is available about the extent of used oil burning in Fairbanks. Calls to local vendors confirmed that used oil is burned, however, no detailed information about the number of facilities and homes burning waste oil or the volumes used has been collected. This measure is designed to collect the information required to formulate a used oil burning program

Analysis

As noted in the introduction, a new regulation 18 AAC 50.078(c) requires used oil burners to submit information on the location, # of burners, rating, operating hours, fuel use/hour, etc.

Conclusion

The adoption of the referenced state regulation is sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required. Once responses are received, DEC will review and analyze the results and will determine in future SIP updates whether they need to be addressed.

Measure R1: Regional Kilns

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/Appendix_III.D.5.07_Adopted_12.24.14.pdf

Background

BACM analysis requirements specified in the final $PM_{2.5}$ rule mandate the consideration of "options not previously considered as RACM/RACT for the area". The moderate SIP considered funding the construction of a Regional Kiln to provide a source of dry wood. The RACM analysis determined the measure to be technologically infeasible because of concerns about the demand for dry wood and emissions from fuels used to dry the wood.

EPA commented that this measure should be further evaluated for BACM and MSM.

Analysis

The review of SIP commitments did not identify a single program which mandates the construction of Regional Kilns to provide a source of dry wood. Instead, several programs implemented measures that require the use of dry wood in solid fuel burning devices. Fairbanks

implemented a requirement that prohibits burning wood that "has more than 20 percent moisture content" in a solid fuel burning appliance.[117]

A review of the RACM analysis shows that the technologically infeasible determination cited potential adverse environmental impacts due to the increase in regional emissions from kiln-dried firewood compared to air-dried firewood because of the fuel required to operate the kiln.

Conclusion

The RACM analysis concerns are still valid. This control measure is technologically infeasible due to adverse environmental impacts and is dismissed from the BACM analysis.

Measure R4: All Wood Stoves Must be Certified

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/Appendix_III.D.5.07_Adopted_12.24.14.pdf

Background

BACM analysis requirements specified in the final $PM_{2.5}$ rule mandate the consideration of "options not previously considered as RACM/RACT for the area". The RACM analysis listed a wood stove measure entitled "All Units Must be Certified". While no analysis of the measure was presented, it was determined to be technologically infeasible. Klamath County was the reference for the measure. The Klamath County Clean Air Ordinance[118] requires:

> *Non-certified wood stoves and fireplace inserts must be removed from building upon sale any building containing them (Section 406.100(3)(c)).*

The Klamath County ordinance also addresses non-certified wood stoves by requiring:

117 http://www.codepublishing.com/AK/FairbanksNorthStarBorough/#!/FNSBC21/FNSBC2128.html#21.28.030

118 https://www.klamathcounty.org/DocumentCenter/Home/View/1020

The resale or installation of a non-certified solid fuel-fired appliance or any appliance not meeting the requirements of Section 406.005(31) is prohibited[119] *(Section 406.100(3)(a)(i)).*

The resale, or installation of an exempt solid fuel-fired appliance, is allowed in accordance with state and local requirements (Section 406.100(3)(a)(ii)).

EPA commented "These measures do not reference the Puget Sound Clean Air Agency (Section 13.07) requirement for removal of all uncertified stoves by September 30, 2015. This is equivalent to having all solid fuel burning appliances be certified and would be more stringent than the current SIP approved rules in Fairbanks. We believe that these measures need to be evaluated in the BACM and MSM analyses." EPA also commented that "All Wood Stoves Must be Certified."

Analysis

As discussed in the analysis of Measures 15 and 17, Alaska's new regulations 18 AAC 50.077(a) & (l) specify that a person may not install, reinstall, sell, lease, distribute, or convey wood-fired heating devices that lack a valid EPA certification under 40 C.F.R. 60.533 or any wood-fired outdoor hydronic heaters, except pellet fueled devices. Subsection (l) also requires all noncompliant devices must be rendered permanently inoperable by December 31, 2024 prior to property conveyance. Alaska's new requirements are significantly more stringent than Klamath County's ordinance removal requirements, which only address uncertified wood stoves; they also address EPA's comments about removal concerns. They are more stringent than those specified in Measure R4 (and Puget Sound Clean Air Agency's Section 13.07) which will provide no additional emission benefits if implemented in the Fairbanks nonattainment area.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure R5: Ban New Installations – Hydronic Heaters

Implementing Jurisdiction(s)

- Utah

Regulation Weblink(s)

- https://rules.utah.gov/publicat/code/r307/r307-208.htm

[119] Section 406.005(31) provides a definition of "Urban Growth Boundary" and appears to be an obsolete reference. Most probably, the reference should be to 406.005(10), which is a definition of "Certified Woodstove or Fireplace Insert".

- http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/Appendix_III.D.5.07_Adopted_12.24.14.pdf

Background

BACM analysis requirements specified in the final $PM_{2.5}$ rule mandate the consideration of "options not previously considered as RACM/RACT for the area". The moderate SIP considered a measure requiring a ban on new installations of hydronic heaters. Analysis of the measure was limited:

> *A ban on new installations would not reduce emissions from hydronic heaters in the near term, but would ultimately reduce emissions as hydronic heaters were retired. However, this approach could have the negative effect of prolonging the use of existing, dirty units because replacing them with newer, much cleaner units would not be allowed. As a result, this measure would not result in quantifiable reductions in the four years after designation.*

The RACM analysis determined the measure to be technologically infeasible because it lacked the authority to implement it. That finding lapsed, but again became effective with voter approval of the Home Heating Reclamation Act in the fall of the 2018.

EPA commented that "Measure R5 describes a similar rule in Utah but lists "none" under implementing jurisdictions. Please make consistent." The reference to Utah was added above under the title of implementing jurisdiction.

Analysis

The review of SIP commitments determined that Utah Rule R-307-208-5 bans the installation of new OWBs; it allows the replacement of existing OWBs with an EPA Phase 2 qualified wood pellet outdoor wood boiler.

Alaska has repealed and replaced 18 AAC 50.077. Subsection (a) prohibits the sale of non-pellet fueled hydronic heaters. Subsection (b) requires pellet fueled hydronic heaters must be certified to 0.10 lb/MMBTU or less to be installed in new construction. Subsection (l) requires hydronic heaters not meeting this requirement to be rendered permanently inoperable by December 31, 2024.

Collectively, the new regulations are more stringent than the Utah requirements.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure R6: Remove Hydronic Heaters at Time of Home Sale

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/Appendix_III.D.5.07_Adopted_12.24.14.pdf

Background

BACM analysis requirements specified in the final $PM_{2.5}$ rule mandate the consideration of "options not previously considered as RACM/RACT for the area". The moderate SIP considered a measure requiring the removal of hydronic heaters at the time of home sale. Analysis of the measure was limited:

> *A requirement to replace hydronic heaters at the time of home sale would not reduce emissions from hydronic heaters in the near term, but would ultimately reduce emissions as hydronic heaters were retired when residential property changed hands. As a result, this measure would not result in quantifiable reductions in the four years after designation. The cost of the measure would be borne by the seller, because the home's sale price would be diminished by the value of the heater that must be removed.*

The analysis did not define or examine what the removed hydronic heaters should be replaced with. Klamath Falls was the reference for the measure. A review of the Klamath County Clean Air Ordinance[120] found a requirement to disclose the presence of all solid fuel-fired appliances upon sale of real property, including wood stoves, fireplace inserts, fireplaces and pellet stoves. The only removal requirement contained in the Ordinance states:

> *Removal of Non-Certified Woodstoves and Fireplace Inserts upon Sale of Real-Property – Non-certified wood stoves and fireplace inserts must be removed from building upon sale of any building containing them. The removal shall be accomplished prior to the closing of any real estate transaction involving the building containing the non-certified wood stove(s) or fireplace insert(s).*

The RACM analysis determined the measure to be technologically infeasible because it lacked the authority to implement it. That finding lapsed, but again became effective with voter approval of the Home Heating Reclamation Act in the fall of the 2018.

While the Borough has no Ordinance addressing the removal of uncertified heating devices from homes being sold, the state of Alaska has mandated a program to remove uncertified wood

[120] https://www.klamathcounty.org/DocumentCenter/Home/View/1020

burning devices during property transactions in the Fairbanks Nonattainment Area; this program became effective June 9, 2017.[121] The regulations require removal or replacement of non-compliant wood-fired heating devices before the sale, lease, or conveyance of property within the Nonattainment Area.

EPA commented that these measures should be evaluated at the state and local level.

Analysis

As noted in the analysis of Measure R5, Alaska has repealed and replaced 18 AAC 50.077. Subsection (a) prohibits the sale of non-pellet fueled hydronic heaters. Subsection (b) requires pellet fueled hydronic heaters must be certified to 0.10 lb/MMBTU or less to be installed in new construction. Subsection (l) requires hydronic heaters not meeting this requirement to be rendered permanently inoperable by December 31, 2024 before it is sold, leased or conveyed as part of an existing structure.

Collectively, the new regulations are more stringent than the Measure R6 requirements and they address EPA comments about the need to evaluate the measure at a state level. Local implementation of any rules for the next 2 years is not possible because of the passage of the Fairbanks Home Heating Reclamation Act, therefore EPA's comment about evaluation at a local level cannot be addressed at this time.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure R7: Ban Use of Hydronic Heaters

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/Appendix_III.D.5.07_Adopted_12.24.14.pdf

Background

BACM analysis requirements specified in the final $PM_{2.5}$ rule mandate the consideration of "options not previously considered as RACM/RACT for the area". The moderate SIP considered banning the use of hydronic heaters. The RACM analysis determined the measure to be

[121] http://dec.alaska.gov/air/anpms/comm/docs/18AAC50.077.pdf

technologically infeasible because it did include a provision for homes with no other adequate source of heat. Another consideration was that on very cold days some residences with alternate heat sources find them to be inadequate and need to supplement with heat from wood combustion.

EPA commented that "Measure R7, Ban Use of Hydronic Heaters, incorrectly identifies that no other SIPs implemented the measure as rationale for not evaluating."

Analysis

The review of SIP commitments did not identify a single program with unrestricted bans on using hydronic heaters. Instead, those programs with curtailments specify the conditions under which curtailments/Air Quality Alerts are called and those programs include a variety of exemptions for homes with NOASH certifications, economic hardship, etc. Fairbanks has implemented a measure mandating Stage 1 and Stage 2 alerts which restrict wood burning when concentrations are forecast to exceed established concentration thresholds (i.e., currently 25 and 35 $\mu g/m^3$ respectively but are being revised to 20 and 30 $\mu g/m^3$). Under these conditions use of hydronic heaters are prohibited except under the exemptions specified in the rule.[122]

While a SIP commitment banning outdoor wood boilers (furnaces, etc.) was not identified, several communities in Connecticut (e.g. West Hartford, Hamden, Avon, etc.) were found to have ordinances banning outdoor wood boilers because of nuisance complaints. Commitments to implementing those ordinances, however are not contained in Connecticut's $PM_{2.5}$ SIP.[123] The SIP references a state statute (Section 22a-174k),[124] which restricted the installation of new outdoor wood burning furnaces until EPA issued regulations for hydronic heaters; it also specified setback requirements for new installations. The recent passage of the Fairbanks Home Heating Reclamation Act, required the removal of any solid fuel burning regulations, so again the Borough lacks the authority to curtail wood stove use. The new state regulations implemented in 18 AAC 50.077 and the Episode Chapter of the $PM_{2.5}$ Serious SIP restrict wood-fired heating device operation, but do not ban all operation.

A review of the RACM analysis shows that there are still technologically infeasible elements for this measure, most notable the lack of exemption for those with no other adequate source of heat.

Conclusion

The RACM analysis concerns are still valid. This control measure is technologically infeasible due to lack of exemption for those with no other adequate source of heat and is dismissed from the BACM analysis.

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122 http://www.codepublishing.com/AK/FairbanksNorthStarBorough/#!/FNSBC21/FNSBC2128.html#21.28.030

123 http://www.ct.gov/deep/cwp/view.asp?A=2684&Q=419074&depnav_GID=1619

124 https://law.justia.com/codes/connecticut/2012/title-22a/chapter-446c/section-22a-174k/

Measure R9: All Wood Stoves Must be Certified

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/Appendix_III.D.5.07_Adopted_12.24.14.pdf

Background

This measure is the same as Measure R4. To preserve the numbering sequence, the text from Measure R4 is repeated here.

BACM analysis requirements specified in the final $PM_{2.5}$ rule mandate the consideration of "options not previously considered as RACM/RACT for the area". The RACM analysis listed a wood stove measure entitled "All Units Must be Certified". While no analysis of the measure was presented, it was determined to be technologically infeasible. Klamath County was the reference for the measure. The Klamath County Clean Air Ordinance[125] requires:

> *Non-certified wood stoves and fireplace inserts must be removed from building upon sale any building containing them (Section 406.100(3)(c)).*

The Klamath County ordinance also addresses non-certified wood stoves by requiring:

> *The resale or installation of a non-certified solid fuel-fired appliance or any appliance not meeting the requirements of Section 406.005(31) is prohibited[126] (Section 406.100(3)(a)(i)).*
>
> *The resale, or installation of an exempt solid fuel-fired appliance, is allowed in accordance with state and local requirements (Section 406.100(3)(a)(ii)).*

EPA commented "These measures do not reference the Puget Sound Clean Air Agency (Section 13.07) requirement for removal of all uncertified stoves by September 30, 2015. This is equivalent to having all solid fuel burning appliances be certified and would be more stringent than the current SIP approved rules in Fairbanks. We believe that these measures need to be evaluated in the BACM and MSM analyses". EPA also commented that "All Wood Stoves Must be Certified."

[125] https://www.klamathcounty.org/DocumentCenter/Home/View/1020

[126] Section 406.005(31) provides a definition of "Urban Growth Boundary" and appears to be an obsolete reference. Most probably, the reference should be to 406.005(10), which is a definition of "Certified Woodstove or Fireplace Insert".

Analysis

As discussed in the analysis of Measures 15 and 17, Alaska's new regulation 18 AAC 50.077(a) and (l) specifies that a person may not install, reinstall, sell, lease, distribute, or convey wood-fired heating devices that lack a valid EPA certification under 40 C.F.R. 60.533 or any wood-fired outdoor hydronic heaters, except pellet fueled devices. Subsection (l) also requires all noncompliant devices be rendered permanently inoperable by December 31, 2024, before it is sold, leased or conveyed as part of an existing structure. Alaska's new requirements are significantly more stringent than Klamath County's ordinance removal requirements, which only address uncertified wood stoves; they also address EPA's comments about removal concerns. The confirmation, removal, destruction and notification requirements are more stringent than those specified in Measure R4 (and Puget Sound Clean Air Agency's Section 13.07) which will provide no additional emission benefits if implemented in the Fairbanks nonattainment area.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure R10: Replace Uncertified Units at the Time of Sale

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/Appendix_III.D.5.07_Adopted_12.24.14.pdf

Background

BACM analysis requirements specified in the final $PM_{2.5}$ rule mandate the consideration of "options not previously considered as RACM/RACT for the area". The moderate SIP considered a measure requiring *replacement of a stove at the time of sale*. Analysis of this measure was limited:

> *A requirement to replace uncertified stoves at the time of home sale would not reduce emissions from wood stoves in the near term, but would ultimately reduce emissions as wood stoves were retired when residential property changed hands. As a result, this measure would not result in quantifiable reductions in the four years after designation. The cost of the measure would be borne by the seller, because the home's sale price would be diminished by the value of the stove that must be removed.*

The analysis did not define or examine what the removed uncertified wood stoves should be replaced with. Klamath Falls was the reference for the measure. A review of the Klamath County Clean Air Ordinance[127] found a requirement to disclose the presence of all solid fuel-fired appliances upon sale of real property, including wood stoves, fireplace inserts, fireplaces and pellet stoves. The only removal requirement contained in the Ordinance states:

> *Removal of Non-Certified Woodstoves and Fireplace Inserts upon Sale of Real-Property – Non-certified wood stoves and fireplace inserts must be removed from building upon sale of any building containing them. The removal shall be accomplished prior to the closing of any real estate transaction involving the building containing the non-certified wood stove(s) or fireplace insert(s).*

The RACM analysis determined the measure to be technologically infeasible because it lacked the authority to implement it. That finding was based on a local voter referendum prohibiting the Borough's regulation of home heating which lapsed. The recent passage of the Fairbanks Home Heating Reclamation Act, required the removal of any solid fuel burning regulations, so again the Borough lacks the authority to remove uncertified wood-fired heaters.

While the Borough has no Ordinance addressing the removal of uncertified heating devices from homes being sold, the state of Alaska has mandated a program to remove uncertified wood burning devices during property transactions in Fairbanks; this program became effective June 9, 2017.[128] The regulations require removal or replacement of non-compliant wood-fired heating devices before the sale, lease, or conveyance of property within the Nonattainment Area.

Analysis

As noted in the analysis of Measures 15, 17, R4/R9 and particularly R6 which addressed the removal of hydronic heaters at the time of home sale, Alaska has repealed and replaced 18 AAC 50.077. Subsections (a) and (l) state a person may not install, reinstall, sell, lease, distribute, or convey wood-fired heating devices that lack a valid EPA certification under 40 C.F.R. 60.533 or any wood-fired outdoor hydronic heaters. Subsection (l) also requires all noncompliant devices be rendered permanently inoperable by December 31, 2024, before it is sold, leased or conveyed as part of an existing structure.

These regulations directly address the replacement of uncertified units at the time of sale as Measure R10 requires.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

[127] https://www.klamathcounty.org/DocumentCenter/Home/View/1020
[128] http://dec.alaska.gov/air/anpms/comm/docs/18AAC50.077.pdf

Measure R11: Replace Uncertified Stoves at the Time of Significant Remodeling

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/Appendix_III.D.5.07_Adopted_12.24.14.pdf

Background

BACM analysis requirements specified in the final $PM_{2.5}$ rule mandate the consideration of "options not previously considered as RACM/RACT for the area". The moderate SIP considered a measure requiring replacement of a stove when significant remodeling occurred. Analysis of the measure discussed:

> *It would probably be enforced during the building permit review and issuance process. The scope and impact of this measure could be controlled by definition of "significant;" it could also be limited to situations where the remodeled room contains a stove. A requirement to replace uncertified stoves at the time of significant remodeling would not reduce emissions from wood stoves in the near term, but would ultimately reduce emissions as wood stoves were retired when residential property was remodeled. As a result, this measure would not result in quantifiable reductions in the four years after designation. The cost of the measure would be borne by the homeowner.*

The RACM analysis determined the measure to be technologically infeasible because it lacked the authority to implement it. That finding was based on a Borough the referendum prohibiting the Borough's regulation of home heating which lapsed. The recent passage of the Fairbanks Home Heating Reclamation Act, required the removal of any solid fuel burning regulations, so again the Borough lacks the authority to remove or replace uncertified wood-fired heaters.

Analysis

As noted in the analysis of Measures 15, 17, R4/R9 and particularly R6 and R10 which addressed the removal of hydronic heaters and uncertified stoves at the time of home sale, Alaska has repealed and replaced 18 AAC 50.077. Subsections (a) and (l) state a person may not install, reinstall, sell, lease, distribute, or convey wood-fired heating devices that lack a valid EPA certification under 40 C.F.R. 60.533 or any wood-fired outdoor hydronic heaters, except pellet fueled devices. Subsection (l) also requires all noncompliant devices be rendered

permanently inoperable by December 31, 2024, before it is sold, leased or conveyed as part of an existing structure.

These regulations directly address the replacement of uncertified units at the time of remodeling that Measure R11 requires.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure R12: Replace Uncertified Stoves in Rental Units

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/Appendix_III.D.5.07_Adopted_12.24.14.pdf

Background

BACM analysis requirements specified in the final $PM_{2.5}$ rule mandate the consideration of "options not previously considered as RACM/RACT for the area". The moderate SIP considered a measure requiring the replacement of uncertified units in rental units. Analysis of the measure was limited:

> *A requirement to replace uncertified stoves in rental units would result in emission reductions upon replacement. The cost of the measure would be borne by the landlords, and presumably passed on to the renter.*

The RACM analysis determined the measure to be technologically infeasible because it lacked the authority to implement it. That finding was based on a Borough the referendum prohibiting the Borough's regulation of home heating which lapsed. The recent passage of the Fairbanks Home Heating Reclamation Act, required the removal of any solid fuel burning regulations, so again the Borough lacks the authority to remove or replace uncertified wood-fired heaters.

EPA commented that this measure should be further evaluated for BACM and MSM.

Analysis

As noted in the analysis of Measures 15, 17, R4/R9 and particularly R6 and R10 which addressed the removal of hydronic heaters and uncertified stoves at the time of home sale,

Alaska has repealed and replaced 18 AAC 50.077. Subsections (a) and (l) state a person may not install, reinstall, sell, lease, distribute, or convey wood-fired heating devices that lack a valid EPA certification under 40 C.F.R. 60.533 or any wood-fired outdoor hydronic heaters, except pellet fueled devices. Subsection (l) also requires all noncompliant devices be rendered permanently inoperable by December 31, 2024, before it is sold, leased or conveyed as part of an existing structure.

These regulations directly address the replacement of uncertified units in all buildings, including rental units that Measure R12 requires and addresses EPA's comments.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure R15: Ban New Installations – Wood Stoves

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/Appendix_III.D.5.07_Adopted_12.24.14.pdf

Background

BACM analysis requirements specified in the final $PM_{2.5}$ rule mandate the consideration of "options not previously considered as RACM/RACT for the area". The moderate SIP considered a measure requiring a ban on new installations of wood stoves. Analysis of the measure was limited:

> *A ban on new installations would not reduce emissions from wood stoves in the near term, but would ultimately reduce emissions as wood stoves were retired; however, this approach could have the negative effect of prolonging the use of existing, dirty units because replacing them with newer, much cleaner units would not be allowed. This measure would not result in quantifiable reductions in the four years after designation.*

Discussion of other wood stove restrictions (e.g., limit the number of new installations allowed in new construction, allow new installations but only if one or more existing stoves were retired first, etc.) was also presented. Ultimately, the RACM analysis determined the measure to be technologically infeasible because it lacked the authority to implement it. That finding was based on a Borough the referendum prohibiting the Borough's regulation of home heating which lapsed. The recent passage of the Fairbanks Home Heating Reclamation Act, required the

removal of any solid fuel burning regulations, so again the Borough lacks the authority to remove or replace uncertified wood-fired heaters.

EPA commented that "Measure R15 is technologically feasible."

Analysis

As noted in Measures 3, 4, 5 and 7, the state has implemented new regulations that establish strict emission ratings for new heating devices and related installation requirements. Those regulations, however do not prohibit the installation of wood-burning devices. Backup heating systems are essential for survival in an arctic environment as loss of primary heating is not an uncommon occurrence with many causes including: extreme cold temperatures, ice storms, fuel supply loss, etc.

ADEC often hears from FNSB residents who have significant concerns regarding the need for non-electric backup heating systems in their homes. Given the subarctic climate and periodic power failures, these individuals have real safety concerns for themselves and their families as well as concerns about damage to their property.

These concerns and expressed needs for reliable backup heat are likely very different in the FNSB nonattainment area than in the lower 48. However, based on the Borough's woodstove changeout/conversion program it is technically feasible to equip a home with adequate backup heating systems that do not rely on solid fuel heating appliances.

Even though it may be technically feasible in certain situations, without widespread availability to natural gas there are limited technologies to provide backup heat to address the safety concerns. While voluntary programs are in place, only 12 emergency power back up systems have been installed through the Borough's program. With the limited number of actual installations, ADEC is cautiously optimistic that the emergency power back up systems will become a proven technology, but at this point the limited installations do not demonstrate that this technology is feasible in every situation. Due to the importance of these systems to ensure citizens safety in an arctic climate, it is not prudent to exclude an entire sector of proven residential heating technology that many citizens rely on for an immediate safety concern.

Conclusion

While this measure is technologically feasible, an economic analysis of its cost effectiveness, presented in Step 4, shows that it is economically infeasible in an arctic environment.

Measure R16: Disincentives to Sell Used Stoves

Implementing Jurisdiction(s)

- None

Regulation Weblink(s)

- http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/Appendix_III.D.5.07_Adopted_12.24.14.pdf

Background

BACM analysis requirements specified in the final $PM_{2.5}$ rule mandate the consideration of "options not previously considered as RACM/RACT for the area". The moderate SIP considered a measure imposing a financial penalty on the sale of a used stove to another user. Analysis of the measure was limited:

> *This measure could apply to all sales of used stoves, or limited to uncertified stoves. There is little environmental benefit to discouraging the sale of a used certified stove; most of the incremental benefit of stove changeout is the difference between uncertified and certified stove emissions.*
>
> *Enforcement of this measure would be much more difficult than enforcement of the requirement that all new stoves be certified. Enforcement of the latter measure requires that vendors be monitored. Enforcement of a penalty on resale would require that transactions involving individual sellers be monitored. This, in turn, might be addressed using a permit or registration system for stove owners.*
>
> *The short-term effectiveness of this measure is low, as the turnover of wood stoves built before 1992 is very slow.*

The RACM analysis determined the measure to be technologically infeasible because it lacked the authority to implement it. That finding was based on a Borough the referendum prohibiting the Borough's regulation of home heating which lapsed.

Borough Code[129] has been updated since the RACM analysis was prepared and Section 21.28.030 (Prohibited acts) mandates:

> *No person shall sell or lease an unlisted solid fuel burning appliance or barrel stove kit in the borough unless the buyer signs an affidavit, on a form prescribed by the borough, attesting that the appliance will not be installed or used in the air quality control zone (Section 21.28.030(H)(1))*

Uncertified wood stoves are not included as a Borough listed solid fuel burning appliance.

The recent passage of the Fairbanks Home Heating Reclamation Act, required the removal of any solid fuel burning regulations, so again the Borough lacks the authority to influence the sale of used stoves

129 http://www.codepublishing.com/AK/FairbanksNorthStarBorough/#!/FNSBC21/FNSBC2128.html#21.28

Alaska regulation at 18 AAC 50.077 prohibits the reinstallation of wood-fired heating devices that do not meet state emission standards within the nonattainment area. While this requirement does not apply to the transfer of property, the state of Alaska has also mandated a program to remove uncertified wood burning devices during property transactions in Fairbanks; this program became effective June 9, 2017.[130] The regulations require removal or replacement of non-compliant wood-fired heating devices before the sale, lease, or conveyance of property within the nonattainment area.

Analysis

As noted in the analysis of Measures 15, 17, R4/R9 and particularly R6 and R10 which addressed the removal of hydronic heaters and uncertified stoves at the time of home sale, Alaska has repealed and replaced 18 AAC 50.077. Subsections (a) and (l) state a person may not install, reinstall, sell, lease, distribute, or convey wood-fired heating devices that lack a valid EPA certification under 40 C.F.R. 60.533 or any wood-fired outdoor hydronic heaters, except pellet fueled devices. Subsection (l) also requires all noncompliant devices be rendered permanently inoperable by December 31, 2024, before it is sold, leased or conveyed as part of an existing structure. Subsection (i) requires wood fired heating devices and wood fired retrofit control devices to be professionally installed with confirmation of proper installation and location. Installers are required to meet certificate criteria established by the National Fireplace Institute Policy Handbook or the Masonry Heater Association of North America as appropriate.

While these regulations do not address the financial disincentives considered in this measure, they go one step further by banning the sale or conveyance of uncertified wood-fired heating device.

Collectively the new regulations are more stringent than the R16 requirements.

Conclusion

The adoption of the referenced state regulations are sufficient to meet the BACM requirements of this measure, therefore the measure is technologically feasible and no additional analysis is required.

Measure R17: Ban Use of Wood Stoves

Implementing Jurisdiction(s)

- None

[130] http://dec.alaska.gov/air/anpms/comm/docs/18AAC50.077.pdf

Regulation Weblink(s)

- http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/Appendix_III.D.5.07_Adopted_12.24.14.pdf

Background

BACM analysis requirements specified in the final $PM_{2.5}$ rule mandate the consideration of "options not previously considered as RACM/RACT for the area". The moderate SIP considered banning the use of wood stoves. The RACM analysis determined the measure to be technologically infeasible because it did not include an exemption for homes with no other adequate source of heat. Another consideration was that on very cold days some residences with alternate heat sources find those sources to be inadequate, and need to supplement with heat from wood combustion.

EPA commented that this measure should be further evaluated for BACM and MSM.

Analysis

The review of SIP commitments did not identify a single program with unrestricted bans on using wood stoves. Instead, those programs with curtailments specify the conditions under which curtailments/Air Quality Alerts are called and those programs include a variety of exemptions for homes with NOASH certifications, economic hardship, etc. Fairbanks has implemented a measure mandating Stage 1 and Stage 2 alerts which restrict wood burning when concentrations are forecast to exceed established concentration thresholds (i.e., currently 25 and 35 $\mu g/m^3$ respectively but are being revised to 20 and 30 $\mu g/m^3$). Under these conditions use of wood stoves are prohibited except under the exemptions specified in the rule.[131] The recent passage of the Fairbanks Home Heating Reclamation Act, required the removal of any solid fuel burning regulations, so again the Borough lacks the authority to curtail wood stove use. The new state regulations implemented in 18 AAC 50.077 and the Episode Chapter of the $PM_{2.5}$ Serious SIP restrict wood-fired heating device operation, but do not ban all operation.

Conclusion

The RACM analysis concerns are still valid. This control measure is technologically infeasible due to lack of exemption for those with no other adequate source of heat and is dismissed from the BACM analysis.

Measure R20: Transportation Control Measures

Implementing Jurisdiction(s)

131 http://www.codepublishing.com/AK/FairbanksNorthStarBorough/#!/FNSBC21/FNSBC2128.html#21.28.030

- None

Regulation Weblink(s)

- http://dec.alaska.gov/air/anpms/comm/docs/fbxSIPpm2-5/Appendix_III.D.5.07_Adopted_12.24.14.pdf

Background

BACM analysis requirements specified in the final $PM_{2.5}$ rule mandate the consideration of "options not previously considered as RACM/RACT for the area". The moderate SIP considered several transportation control measures, including:

- HOV lanes
- Traffic flow improvement program
- Create non-motorized traffic zones
- Employer-sponsored flexible work schedules
- Retrofit diesel fleet (school buses, transit fleets)
- On-road vehicle I/M program
- Heavy-duty vehicle I/M program
- State LEV program

Transportation control programs in place at the time included:

- Expanded availability of plug-ins; electrical outlets were installed on 1,500+ parking spaces between 2008 & 2015
- Ordinance mandating—for employers with 275+ parking spaces—electrification of outlets at temps < 21° F between November 1 and March 31
- Public education focused on the benefits of plugging-in and using the transit program called Metropolitan Area Commuter System (MACS)
- Expanded transit service includes improved service frequency on high ridership routes, new routes and better bus stop facilities; ridership increased 61% between 2008 & 2013
- Commuter Van Pool program, includes Van Tran program for elderly and disabled
- Anti-idling program for heavy-duty diesel vehicles started as a ADOT&PF program focused on dump trucks and tractors and has been expanded to a CMAQ-funded pilot program focused on the purchase and installation of auxiliary heaters to reduce idle time in private fleets.
- Federal Motor Vehicle Control Program

The analysis of these measures found:

> *With the exception of the anti-idling program, the programs listed above have been in place for well over a decade and are working to reduce motor vehicle emissions under extreme winter operating conditions.*

Measures focused on reducing traffic congestion offer limited benefits as the Fairbanks road network has few roads operating at Level of Service (LOS) levels D, E, or F.

Community-wide ridesharing programs offer few potential emission reduction benefits because of the low population and employment density in the nonattainment area (employer programs are operated where sufficient density supports participation).

Travel reduction programs have been found to have limited benefits on a national basis, with principal reductions coming from commute trips, which require high density employment to be successful.

EPA's motor vehicle emissions model MOVES, including the recently released version MOVES2014b, does not provide a PM benefit for either light- or heavy-duty I/M programs. Thus, there is no way to quantify a particulate benefit from I/M, and EPA clearly does not recognize I/M as an appropriate PM control measure.

This resulted in a finding that no additional TCMs appear viable for Fairbanks. Because TCMs are not expected to provide additional reductions, all TCMs are classified as "not technologically feasible."

EPA comments on this measure were limited to inspection/maintenance (I/M) programs and vehicle idle restrictions (which were addressed separately in Measure 60). With regard to I/M, EPA commented that the finding that I/M is technologically infeasible because MOVES2014b is not a valid conclusion. They noted that the Utah Cache Valley has a I/M program for VOC and Fairbanks had previously operated an I/M program for carbon monoxide (CO) and this measure needed to be evaluated.

Analysis

EPA and FHWA have devoted considerable resources to develop tools to analyze the benefits of Transportation Control Measures (TCMs) as they were intended to help reduce mobile source emissions through transportation efficiency improvements and reductions in vehicle miles of travel. Independent analyses by the NCHRP (a division of the Transportation Research Board) and ASHTO (the American Association of State Highway and Transportation Officials), have documented that the initial enthusiasm for including TCMs in SIPs has diminished as states have gained experience with their benefits and learned that they produce small emission reductions as compared with those produced by technological advancements that produce cleaner vehicles and fuels. Thus, while CMAQ funding is being used to support the implementation of a variety of transportation measures in many communities, less emission reduction credit is being taken for them and they are more frequently being implemented as voluntary measures, for which emission reduction credit is limited.

The Moderate SIP, approved by EPA, identified the measures that have been implemented in Fairbanks and reached the following findings with regard to the implementation of additional measures:

- Measures focused on reducing traffic congestion offer limited benefits as the Fairbanks road network has few roads operating at Level of Service (LOS) levels D, E, or F.
- Community-wide ridesharing programs offer few potential emission reduction benefits because of the low population and employment density in the nonattainment area (employer programs are operated where sufficient density supports participation).
- Travel reduction programs have been found to have limited benefits on a national basis, with principal reductions coming from commute trips, which require high density employment to be successful.

This resulted in the conclusion that no additional TCMs appear viable for Fairbanks. Because TCMs were not expected to provide additional reductions, all TCMs were classified as "not technologically feasible".

The BACM analysis revisited these findings and determined that they had not changed - additional transportation control measures are technologically infeasible and not eligible for BACM. Both the BACM finding on motor vehicle controls and the EPA comment on the BACM finding for motor vehicle controls are incorrect.

The earlier BACM conclusion incorrectly stated:

> *Findings for the transportation controls examined in the RACM analysis have not changed, these measures <u>are technologically infeasible</u> and not eligible for BACM.* (emphasis added)

EPA incorrectly stated:

> *The BACM assessments of motor vehicle related controls incorrectly identifies that <u>emissions benefits are not quantifiable</u> as a rationale for dismissal of controls.* (emphasis added)

With regard to the BACM finding, transportation control measures are technologically feasible; they have been implemented all over the country. That said, independent studies have documented that while states and communities continue to adopt them, where funding is available, growing experience in lower-48 states has demonstrated emissions benefits are limited. As a result, credit for TCMs in SIPs has diminished. This finding and the prospect of limited cost effective benefits in a low density arctic community supports Fairbanks decision not to include any additional TCMs in the Serious SIP. The text of the BACM document is revised to clarify this finding.

With regard to the EPA finding, as shown in the conclusion listed above, the BACM analysis did not claim the emissions benefits of motor vehicle controls are not quantifiable. It did state:

> *Finally, the latest version of EPA's Motor Vehicle Emissions Simulator MOVES2014a continues to show no $PM_{2.5}$ benefits for either light- or heavy-duty I/M programs. Thus,*

> *there is no way to quantify a particulate benefit from I/M, and EPA clearly does not recognize I/M as an appropriate $PM_{2.5}$ control measure.* (emphasis added)

The latest MOVES release is MOVES14b and it continues to show no $PM_{2.5}$ benefits for either light- or heavy-duty I/M programs. Until EPA approves a methodology for quantifying $PM_{2.5}$ benefits of I/M programs, the state cannot claim a benefit for it in the Serious SIP. Thus, the state agrees that the benefits of motor vehicle idling controls, if they exist, cannot be quantified or used in the emission inventory calculations until a methodology is approved by OTAQ.

With regard to EPA's comment about the need to assess the VOC benefits of an I/M program, the Moderate precursor analysis[132] and the 2019 update contained in the Modeling Chapter found that neither VOC nor NOx are significant precursor pollutants in the Fairbanks $PM_{2.5}$ nonattainment area. Thus, there is no technical basis to pursue an assessment of the costs and benefits of a I/M program for either VOC or NOx.

Conclusion

Findings for the transportation controls examined in the RACM analysis have not changed, these measures are technologically infeasible and not eligible for BACM.

Measure R29: Increase Coverage of the District Heating System

Implementing Jurisdiction(s)

- Fairbanks North Star Borough

Regulation Weblink(s)

- None

Background

Many residential, commercial, and institutional buildings within downtown Fairbanks are connected to a district heating system that supplies low pressure steam or hot water for space heating and domestic hot water use. Use of the district heating systems allows for the widespread use of energy produced by a central steam generating unit with effective emissions controls. These systems essentially eliminate the need for the operation of individual fuel combustion heating units in each of the facilities receiving heat from a central plant.

Even considering transmission losses, a well maintained and operated central heating facility can be much more efficient than individual combustion units, especially those that burn wood, coal, or oil. Emissions from a central facility are released into the atmosphere at a much greater height

[132] http://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-serious-sip-development

above grade than those of combustion units in individual buildings and, as a result, disperse more widely.

Aurora Energy operates a coal-fired cogeneration power plant that recycles low pressure steam for district heating use. Aurora Energy provides district heating (in the form of low-pressure steam or hot water) to approximately 180 customers. Customers range in size from small residential to large commercial/institutional loads.

Analysis

Aurora commissioned a study[133] in 2008 to examine the feasibility of expanding the underground network of pipes that deliver steam and hot water. Based on the information presented in that study, the RACM analysis determined this measure to be technologically feasible. Aurora provided updated heating expansion cost information in 2018.[134]

Conclusion

No information has become available to change the RACM analysis conclusion about the technological feasibility of this measure; therefore, this measure is technologically feasible and eligible for consideration as BACM. The results of a cost effectiveness analysis of this measure, presented in Step 4, show this measure is economically infeasible..

[133] PDC, Inc. Engineers, *Aurora Energy District Heat Capacity Study, Phase 2*, December 2008
[134] Email from Matt Burdick, PE, Project Engineer, Aurora Energy to Bob Dulla, Trinity Consultants, October 12, 2018

5. Step 4 – Determine Whether an Available Control Technology or Measure is Economically Feasible

EPA guidance[135] on determining the economic feasibility of technically feasible control measures was followed to calculate the cost per ton of pollutant reduced. Key cost information collected to support the preparation of the $/ton calculation included:

- Material/equipment prices (local purchase price, etc.)
- Labor (inspection, installation, maintenance, etc.)
- Program costs associated with implementing new control measures (including staff, software development, overhead, etc.)
- Maintenance costs (local labor and parts)
- Connection fees as appropriate (e.g., trenching, parts, etc.)
- Useful life – ranged between 8 and 30 years depending on the device lifespan
- Capital recovery rate – assumed to be 5.5%
- Existing fuel prices (documented by the Fairbanks Community Planning Department)
- Distillate fuel price forecasts (using EIA Pacific Region forecasts)
- Impact of market shifts on home heating fuel supply costs contained in the Appendix to Chapter 7
- Energy content of heating fuels (based on fuel sold in the Borough and reported by local suppliers)
- Combustion efficiency changes associated with the implementation of selected control measures
- Changes is home heating activity associated with measures addressing curtailment
- Changes in NOASH permits
- Changes in heating systems incorporated into new homes

The above information was used to calculate the annualized cost of operating current heating devices and the annualized cost of implementing individual measures for those devices consistent with the assumptions employed in the 2019 emissions inventory. A summary of the cost per ton of $PM_{2.5}$ reduced for each of the technically feasible measures is presented below in Table 9. The results indicate that only one of the technically feasible measures is cost effective, a shift from No. 2 to No. 1 home heating oil, the rest of the measures are not cost effective and have not been selected for implementation. A requirement mandating the shift in home heating oil has been incorporated into 18 AAC 50.078(b).

[135] Federal Register/Vol. 81, No. 164, August, 24, 2016, page 55805

Table 9. Assessment of Economic Feasibility for Technically Feasible Control Measures (Cost Effectiveness Estimate)

Measure #	Measure Description	$/ton of $PM_{2.5}$ Reduced
8	Prohibit Installation of Solid Fuel Heating Device in New Construction	24,845
51a.	No. 2 to No. 1 home heating oil	7,290,359
51b.	No. 2 to ULS home heating oil	-40,728
52	Operation and sale of small "pot burners" prohibited	1,371,455
53	No sale or exchange of used oil for fuel unless it meets constituent property limits Ban	18,308,596
R15	Ban New Installations – Wood Stoves	25,434
61	EPA – Fuel oil boiler upgrade – burner upgrade/repair	70,448,210
62	EPA – Fuel oil boiler upgrade - replacement	7,002,188
R29	Increase Coverage of the District Heating System	617,335
Measure #	**Measure Description**	**$/ton of SO_2 Reduced**
51a.	No. 2 to No. 1 home heating oil	-10,529
51b.	No. 1 to ULS home heating oil	1,729

The above estimates of Measure 51 cost effectiveness reflect revisions prepared to address comments received from EPA and refiners. In summary, those comments addressed:

- Presentation of the impact of regulations on the sulfur emissions from industrial and residential boilers;
- Documentation and spreadsheets supporting the cost per device and cost effectiveness of fuel changes;
- Expansion of the time period analyzed for fuel price differences and related elasticity estimates;
- Assumptions about the transition of JP4 to JP8;
- Assumptions about the Higher Heating Values of heating oils; and
- Assumptions about supply and transportation costs.

The revisions to these assumptions and related documentation are incorporated into the attached cost effectiveness spreadsheets. The results show that changes in fuel use from both measures produce an increase in $PM_{2.5}$ emissions, which moot any consideration of their cost effectiveness. The more important impact of these measures is on SO_2 emissions and the results show that while both measures produce a reduction in SO_2, the shift from No. 2 to No. 1 provides a reduction in cost, while the shift from No. 2 to ULS produces an increase in cost. Thus, the negative cost effectiveness of the shift from No. 2 to No. 1 is more cost effective.

Revisions to the supplier analysis also determined that a switch from Diesel #2 to ULSD would require all fuel oil for space heating be imported by truck or rail into the community at a cost premium as described in the analysis and supporting economic assessment. The very large

change in fuel supply required to achieve this shift further supports ADEC's finding that a switch from Diesel #2 to ULSD is cost ineffective.

In recognition of these findings, 18 AAC 50.078 has been amended, subsection (b) mandates that starting September 1, 2022 only fuel oil containing 1000 ppm sulfur may be sold for use in home and commercial heating.

#

6. Step 5 – Determine the Earliest Date by Which a Control Measure or Technology can be Implemented in Whole or in Part

The Step 3 technological feasibility analysis identified 40 separate measures the state is addressing through the adoption of new regulations. All of those measures are considered to be both technologically and economically feasible. The Step 4 economic feasibility analysis considered 8 separate measures and determined that only the Measure 51 shift from No. 2 to No. 1 home heating oil is economically feasible. A summary of the 41 control measures determined to be both technologically and economically feasible is listed in Table 10 below. While some of the regulations implementing portions of the measures are already in place and not displayed in the table, all of the measures are being implemented in whole or in part by new state regulations and in the Episode Chapter of the $PM_{2.5}$ Serious SIP. Those regulations are displayed along with the date of implementation in Table 10. As can be seen, all of the technologically feasible and economically feasible measures are to be implemented at the effective date of regulation, with exceptions noted.

Table 10. BACM Implementation Dates

Measure #	Measure Description	Enabling Regulation	Start Date
2	Prohibit advertising used devices that do not meet emission criteria for new device sales	18 AAC 50.077(k)	Effective date of the regulation
3	Require building or other permit	18 AAC 50.077(j)(2)	Effective date of the regulation
4	Require confirmation of proper installation by requiring professional installation or on-site inspection	18 AAC 50.077(i)	Effective date of the regulation
5	Register/require industry certification of heating professionals	18 AAC 50.077(i)	Effective date of the regulation
7	Require devices meet stricter emission criteria in high pollution zones	18 AAC 50.077(b), (c), (d) & (e)	Effective date of the regulation
13	Submit sale and installation Information to Air Program	18 AAC 50.077(a), (b), (h), (l), (k), (i) & (j)	Effective date of the regulation
15	Disclosure of devices on property sale	18 AAC 50.077(a), (h), (l) & Episode Chapter	Effective date of the regulation
16	Require notice and proof of destruction or surrender of removed, uncertified devices	18 AAC 50.077(a), (l), (m), (h) & Episode Chapter	Delayed effective date, see text below

Table 10. BACM Implementation Dates

Measure #	Measure Description	Enabling Regulation	Start Date
17	Require Removal of Uncertified Solid Fuel Burning Devices Upon Sale of Property	18 AAC 50.077(a), (l), (m) & Episode Chapter	Effective date of the regulation
19	Require registration of devices to qualify for exemption from curtailments	18 AAC 50.077(h)(3) & Episode Chapter	Effective date of the regulation
20	Require renewals with inspection requirements	18 AAC 50.077(h) & Episode Chapter	Effective date of the regulation
21	Optional device registration for curtailment exemptions	18 AAC 50.077(h)(3) & Episode Chapter	Effective date of the regulation
22	Require registration of all devices	18 AAC 50.077(h), (c), (d) & (n)	Effective date of the regulation
24	Require permanent Installed Alternative Heating Method in Rental Units	18 AAC 50.077(j)	Effective date of the regulation
25	Require detailed application or inspection to verify need	Episode Chapter	Effective date of the regulation
26	Require inspection of devices and installation	18 AAC 50.077(i)	Effective date of the regulation
27	Require annual renewal of waiver	Episode Chapter	Effective date of the regulation
28	Set income threshold	Episode Chapter 18 AAC 50.077(a) & (l)	Effective date of the regulation
29	Allow only NOASH households to burn during curtailment periods	Episode Chapter	Effective date of the regulation
30	Distribution of Curtailment Information at Time of Sale of Wood-Burning Device	18 AAC 50.077(k)(2)	Effective date of the regulation
31	Require sale of only dry wood during late summer to end of winter	18 AAC 50.077(d), (e), (g), (j), (k) & (l)	Delayed effective date, see text below
32	Require dry wood to be clearly labeled to prohibit marketing of non-dry wood as dry wood; Distribution of Information Related to Moisture Content at Time of Wood Sale	18 AAC 50.077(d), (e), (g), (j), (k) & (l)	Delayed effective date, see text below
40	Single Stage Curtailment	18 AAC 50.077(a), (l) & Episode Chapter	Effective date of the regulation
42	Burn down period	18 AAC 50.075(e)	Effective date of the regulation

Table 10. BACM Implementation Dates

Measure #	Measure Description	Enabling Regulation	Start Date
48	Date certain removal of "coal only heater"	18 AAC 50.079(f)	Delayed effective date, see text below
49	Prohibit use of coal burning heaters	18 AAC 50.079(f)	Delayed effective date, see text below
51	Shift from # 2 to #1 heating oil	18 AAC 50.078(b)	Delayed effective date, see text below
65	Emissions crossing property lines	18 AAC 50.075(f)(2)	Effective date of the regulation
66	Lower curtailment threshold	Episode Chapter	Effective date of the regulation
67	Coffee Roasters - Commercial	18 AAC 50.078(d)	1-yr after the effective date of the regulation
68	Charbroilers - Commercial	18 AAC 50.078(c)	Effective date of the regulation
69	Incinerators - Commercial	18 AAC 50.078(c)	Effective date of the regulation
70	Used oil burners	18 AAC 50.078(c)	Effective date of the regulation
R4	All units must be certified	18 AAC 50.077(a) & (l)	Effective date of the regulation
R5	Ban new installations - hydronic heaters	18 AAC 50.077(a), (b) & (l)	Effective date of the regulation
R6	Remove hydronic heaters at time of home sale	18 AAC 50.077(a), (b) & (l)	Effective date of the regulation
R9	All wood stoves must be certified	18 AAC 50.077(a) & (l)	Effective date of the regulation
R10	Replace uncertified units at time of sale	18 AAC 50.077(a) & (l)	Effective date of the regulation
R11	Replace uncertified units at time of significant remodeling	18 AAC 50.077(a) & (l)	Effective date of the regulation
R12	Replace uncertified stoves in rental units	18 AAC 50.077(a) & (l)	Effective date of the regulation
R16	Disincentives to sell used stoves	18 AAC 50.077(a), (i) & (l)	Effective date of the regulation

EPA comments requested discussion of the rationale for measures and regulations with delayed implementation dates and an explanation as to why the selected dates represented the most expeditious possible. Listed below is text addressing the rationale for the selected dates.

Measure 16 – BACM Measures 16, 48, & 49 and 18 AAC 50.077(b) require date certain removal of all EPA uncertified devices, all outdoor hydronic heaters (except outdoor pellet fueled hydronic heaters), and all existing coal-fired heating devices to be removed or replaced by December 31, 2024.

Alaska's new regulations 18 AAC 50.077(a) and (l) specify that a person may not install, reinstall, sell, lease, distribute, or convey wood-fired heating devices that lack a valid EPA certification under 40 C.F.R. 60.533 or any wood-fired outdoor hydronic heaters, except pellet fueled devices. All noncompliant devices must be rendered permanently inoperable by December 31, 2024, prior to property conveyance.

The current device inventory estimates that approximately 13,418 wood burning appliances are in the nonattainment area with 2,553 of those appliances estimated to be uncertified. Estimates also show approximately 481 coal fired residential heaters in the nonattainment area for a total of 3,034 appliances that need to be removed. Current funding for the Borough's wood stove change out program show that, including the 2018 Targeted Air Shed grant award, the total projected change outs achievable from 2019 through 2024 are 1,290. The date of 2024 provides residents adequate time to participate in the wood stove change out program in order to comply with the regulation without overwhelming the Borough program resources.

Measure 31 – BACM Measures 31 and 32 and 18 AAC 50.076(d) & (j) require commercial wood sellers to ensure that wood being sold has a moisture content less than 20%, effective October 1, 2021.

Lacking infrastructure, such as kiln capacity sufficient to dry a season's worth of wood, the only technically feasible method of drying commercially available cordwood to less than 20% moisture content is to air dry the wood. A study of the time required to dry wood in Fairbanks[1] found that a minimum of six summer months with covered storage is required to dry wood from spring cutting to a moisture level below 20%. However, ADEC regulation 18 AAC 50.076 (k) has set the minimum of 9 months drying time, unless confirmed, to ensure that the wood is dry given the variation in wood drying with different storage options. The same study determined that wood cut in the fall dries much more slowly and essentially stops drying once the wood becomes frozen. At this time the community lacks adequate storage space to dry the wood required to fill the commercial market. The summer of 2020 would be used by the commercial wood sellers to secure the space and construct structures to air dry the wood. Cord wood harvested during the spring of 2021 could then be stored and dried by October 2021 which is the most expeditious schedule that the commercial wood industry can follow to meet the requirements of this rule.

Measure 32 – BACM Measures 31 and 32 and 18 AAC 50.076(d) & (j) require commercial wood sellers to ensure that wood being sold has a moisture content less than 20%, effective October 1, 2021.

As discussed above in the analysis of Measure 32, wood sellers currently lack the infrastructure required to dry and store a season's worth of commercial firewood. Time will be required for wood sellers to secure the space and construct the structures to air dry wood. The summer of 2020 will be the earliest opportunity for commercial wood sellers to secure the space and construct structures to air dry the wood. Cord wood harvested during the spring of 2021 could then be stored and dried by October 2021 which is the most expeditious schedule that the commercial wood industry can follow to meet the requirements of this rule.

Measure 48 – BACM Measures 16, 48, & 49 and 18 AAC 50.077(l) require owners to render all noncompliant devices permanently inoperable by December 31, 2024. Similar requirements apply to existing coals fired heating devices.

The current device inventory estimates that approximately 13,418 wood burning appliances are in the nonattainment area with 2,553 of those appliances estimated to be uncertified. Estimates also show approximately 481 coal fired residential heaters in the nonattainment area for a total of 3,034 appliances that need to be removed. Current funding for the Borough's wood stove change out program show that, including the 2018 Targeted Air Shed grant award, the total projected change outs achievable from 2019 through 2024 are 1,290. The date of 2024 provides residents adequate time to participate in the wood stove change out program in order to comply with the regulation without overwhelming the Borough program resources.

Measure 49 – BACM Measures 16, 48, & 49 and 18 AAC 50.077(l) require owners to render all noncompliant devices permanently inoperable by December 31, 2024. Similar requirements apply to existing coals fired heating devices.

As noted above, the current device inventory estimates that approximately 13,418 wood burning appliances are in the nonattainment area with 2,553 of those appliances estimated to be uncertified. Estimates also show approximately 481 coal fired residential heaters in the nonattainment area for a total of 3,034 appliances that need to be removed. Current funding for the Borough's wood stove change out program show that, including the 2018 Targeted Air Shed grant award, the total projected change outs achievable from 2019 through 2024 are 1,290. The date of 2024 provides residents adequate time to participate in the wood stove change out program in order to comply with the regulation without overwhelming the Borough program resources.

Measure 51 – BACM Measure #51 and 18 AAC 50.078(b) address an areawide fuel oil switch from #2 heating oil to #1 heating oil with a starting date of July 1, 2022.

ADEC had originally proposed a July 1, 2020 start date, but received a number of adverse comments from the public and industry associated with the proposed implementation of this measure in 2020. The switch from #2 heating oil to #1 heating oil will require an infrastructure change on the part of the local refinery and local fuel distribution systems and has an estimated economic impact that individuals indicated would drive more residents to using wood/solid fuel heat. With the timing of the final

Serious SIP being released in the middle of the 2019/2020 heating system it would be technically infeasible to require the local refineries and fuel distributors to make this change in the middle of a heating system and given the adverse comments, a starting date prior to the 2022/2023 heating season was chosen to provide time for the local refinery, fuel distributors, and residents to prepare and budget for a switch to #1 fuel oil. The slightly longer timeframe for implementation also provides the opportunity for residents to consider and take advantage of the expanded natural gas service planned for the community in the coming few years.

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7. BACM Findings

The BACM analysis considered 84 separate control measures. The disposition of those measures is as follows:

- 6 – did not meet the definition for BACM and were dismissed,
- 22 – were determined to be technically infeasible and were dismissed,
- 8 - were found to be adopted in different form with no further analysis required
- 48 - measures were determined to be technologically feasible,
- 40 – of the technologically feasible measures were adopted through new state regulations and therefore technologically and economically feasible, and
- 8 – of the remaining technologically feasible measures were assessed for economic feasibility; 1 of the 8 was determined to be economically feasible and adopted through new state regulation.

The result is that a total of 41 measures were selected as BACM. The selected measures address a wide range of space heating, area source, commercial source and transportation activity categories represented in emissions inventory. While this document has not quantified the benefits of all of the selected measures, their implementation will substantially reduce directly emitted $PM_{2.5}$ and related precursor emissions and aid community/state efforts to achieve attainment of the ambient 24-hour $PM_{2.5}$ standard.

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Appendices

A copy of the state's report entitled *Residential Fuel Expenditure Assessment of a Transition to Ultra-Low Sulfur and High Sulfur No. 1 Heating Oil for the Fairbanks PM-2.5 Serious Nonattainment Area* is contained in the Appendix III.D.7 Control Strategies of the $PM_{2.5}$ Serious SIP.

#

By: Leah Berman Williams
Marna Sanford
Shaun Tacke
Liz Lyke
Introduced: 03/14/2019
Adopted: 03/14/2019

FAIRBANKS NORTH STAR BOROUGH

RESOLUTION NO. 2019 – 08

A RESOLUTION SUPPORTING LEGISLATION GRANTING THE ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION, DIVISION OF AIR QUALITY THE AUTHORITY TO ISSUE CIVIL FINES FOR VIOLATIONS IN AREAS CLASSIFIED AS SERIOUS NONATTAINMENT AREAS

WHEREAS, The United States Environmental Protection Agency (EPA) in December 2009, declared part of the Fairbanks North Star Borough (Borough) a non-attainment area for fine particulate pollution (PM2.5); and

WHEREAS, On December 16, 2016 the EPA published public notice in the Federal Register of its intent to reclassify the Borough non-attainment area from Moderate to Serious status, and the Final Rule was signed on April 28, 2017; and

WHEREAS, A coalition of community partners assembled an Air Quality Stakeholders Group to identify, evaluate and recommend community based solutions to bring the area into compliance with federal air quality standards for fine particulates ($PM_{2.5}$); and

WHEREAS, One of the recommendations of the Air Quality Stakeholders Group is that legislation be adopted granting the Alaska Department of Environmental Conservation (ADEC) administrative penalty authority in order to ensure compliance with and enforcement of state laws and regulations; and

WHEREAS, The ability to impose a civil fine in an area classified as a serious nonattainment area or to meet provisions adopted within a State Air Quality Control Plan is a much needed component of an effective curtailment program.

NOW THEREFORE BE IT RESOLVED that the Assembly of the Fairbanks North Star Borough supports legislation granting the Alaska Department of Environmental Conservation, Division of Air Quality the authority to issue civil fines for violations in areas classified as serious nonattainment areas.

BE IT FURTHER RESOLVED that a copy of this resolution shall be delivered to Governor Michael J. Dunleavy, the members of the Alaska Senate, and the Alaska House of Representatives.

PASSED AND APPROVED THIS 14TH DAY OF MARCH 2019.

Angela Major, Deputy
Presiding Officer

ATTEST:

April Trickey, CMC
Borough Clerk

Yeses: Williams, Quist, Tacke, Sanford, Lyke, Major
Noes: Lojewski
Other: Gray (Excused), Cooper (Excused)

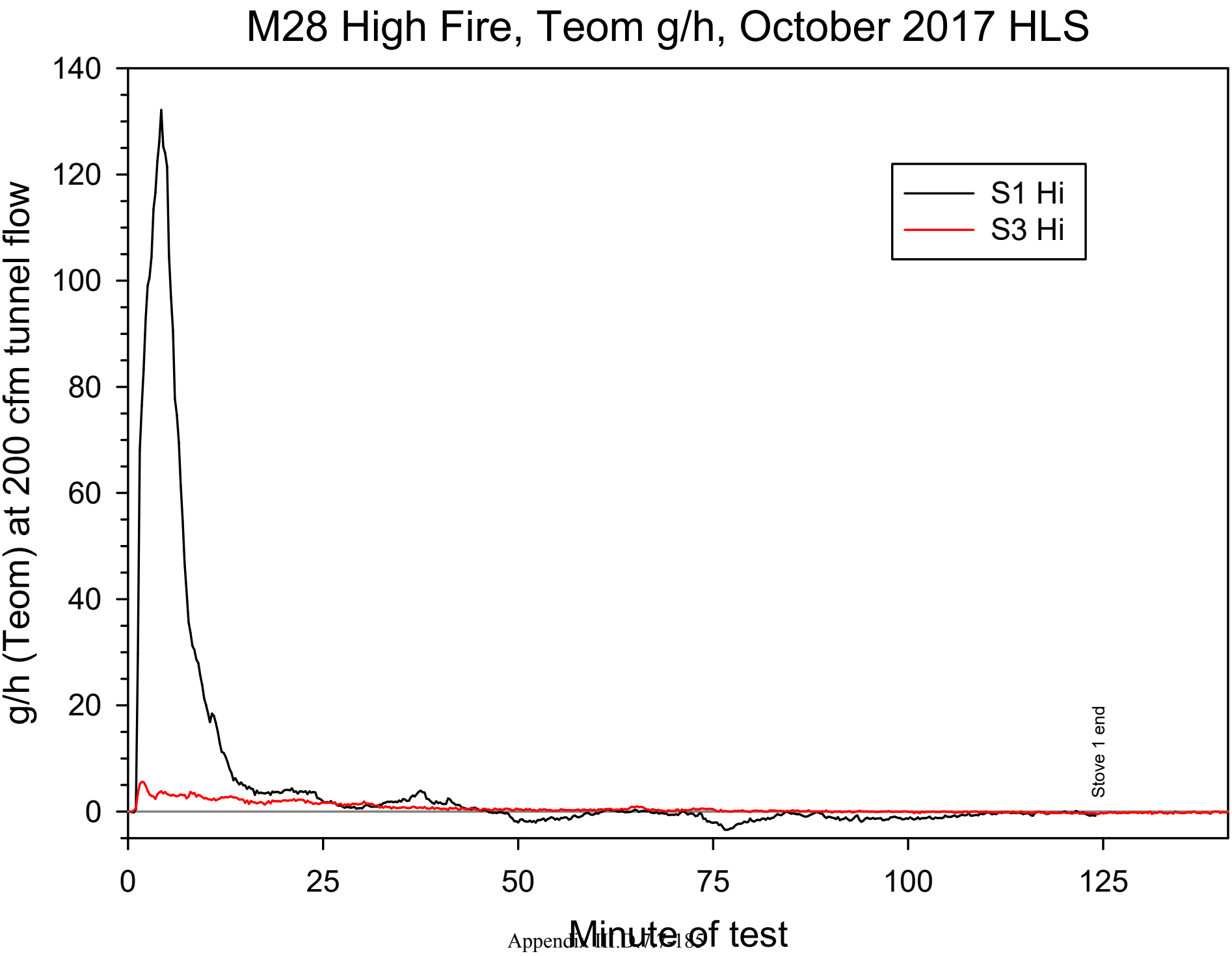
NESCAUM
Northeast State for Coordinated Air Use Management

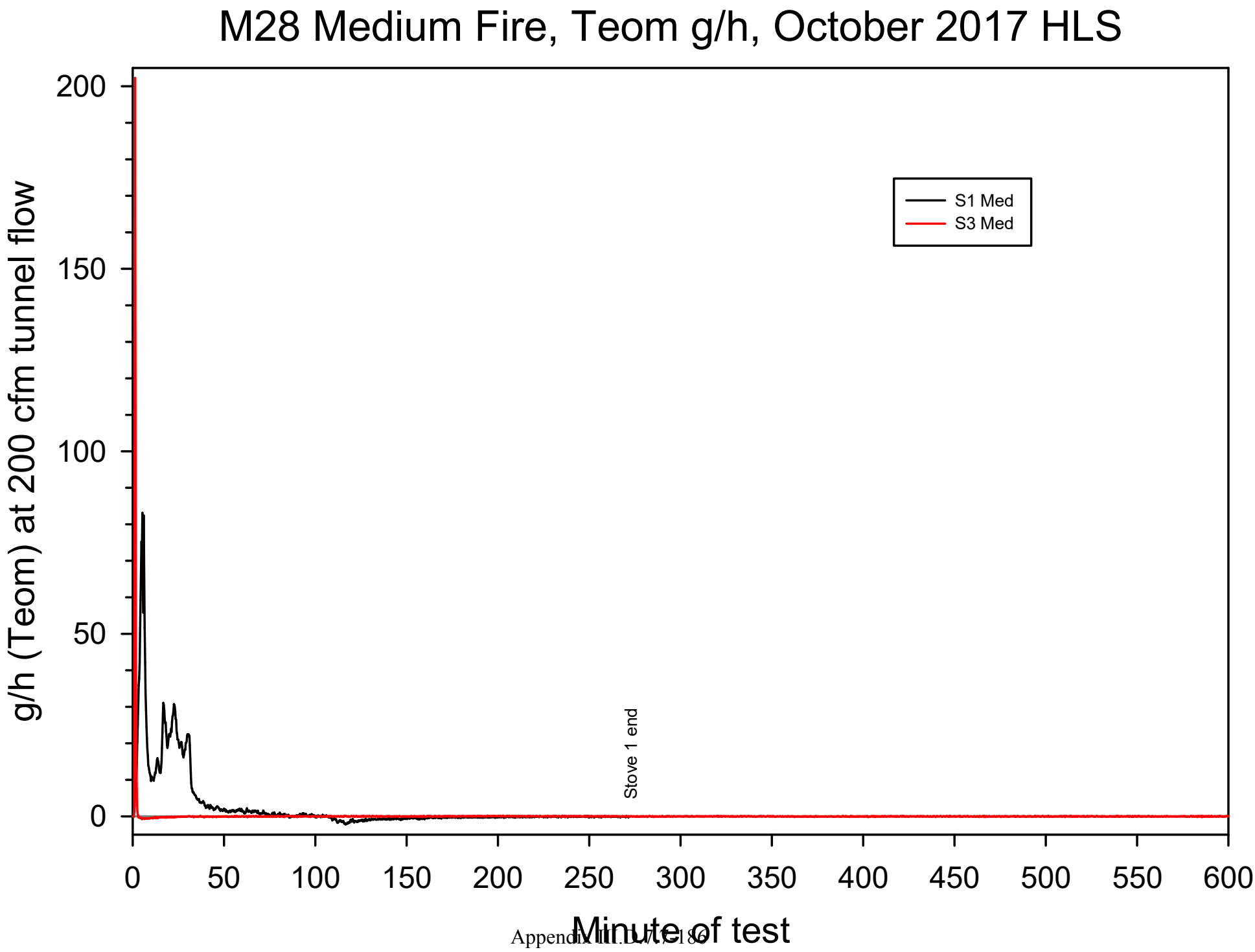
2017 partial results

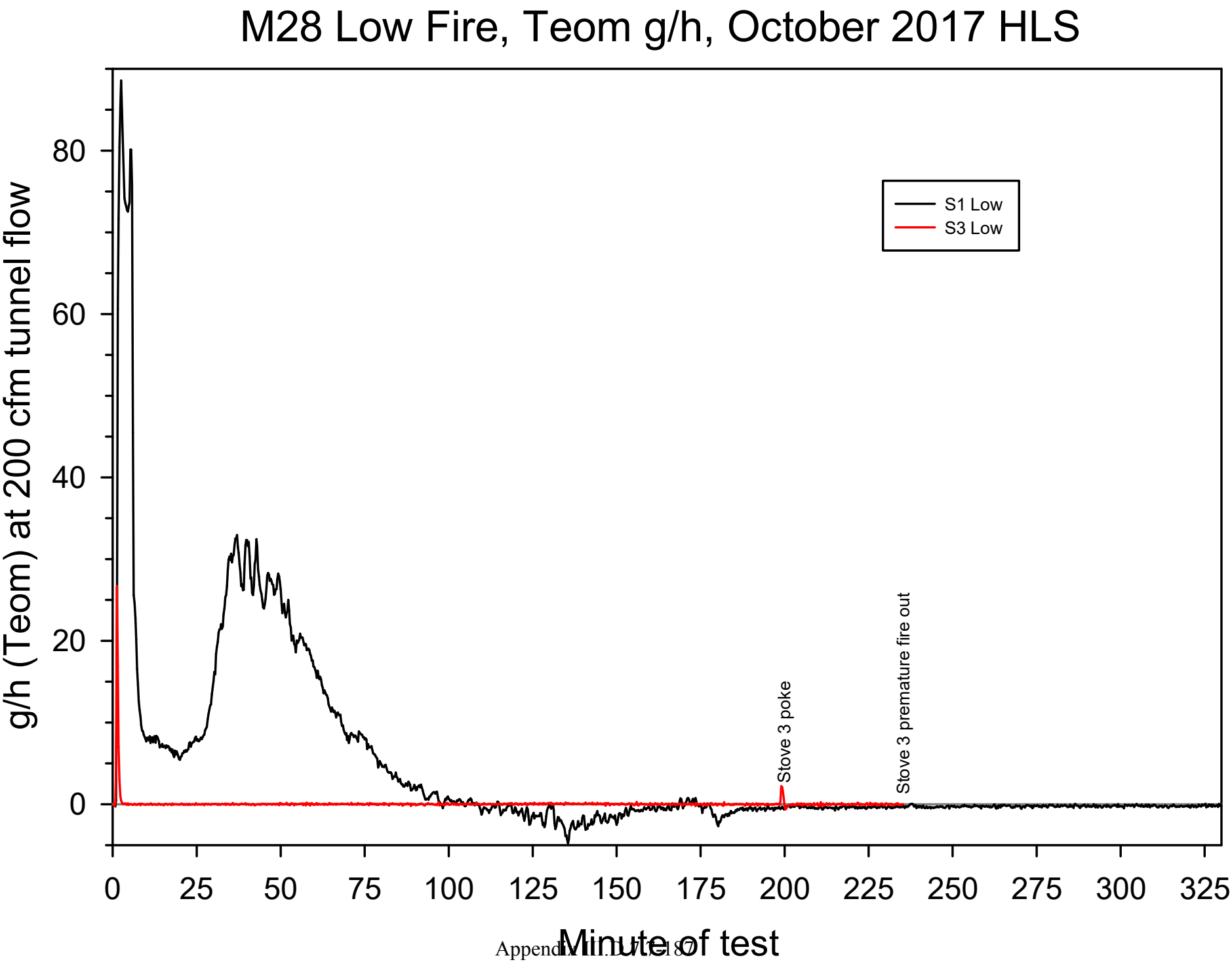
Comparison of Emission Profiles

Catalyst vs Non-Catalyst Woodstove

Using EPA Method 28 combined with tapered element oscillating microbalance (TEOM) during the Hi, Low, and Medium Fire


M28 High Fire, Teom g/h, October 2017 HLS
g/h (Teom) at 200 cfm tunnel flow
140
120
100
80
60
40
20
0
0
25
50
75
100
125
Minute of test
S1 Hi
S3 Hi
Stove 1 end


M28 Medium Fire, Teom g/h, October 2017 HLS
g/h (Teom) at 200 cfm tunnel flow
Minute of test
S1 Med
S3 Med
Stove 1 end
0
50
100
150
200
250
300
350
400
450
500
550
600


M28 Low Fire, Teom g/h, October 2017 HLS
g/h (Teom) at 200 cfm tunnel flow
Minute of test
S1 Low
S3 Low
Stove 3 poke
Stove 3 premature fire out
0
20
40
60
80
0
25
50
75
100
125
150
175
200
225
250
275
300
325

Alaska Department of Environmental Conservation

Residential Fuel Expenditure Assessment of a Transition to Ultra-Low Sulfur and High Sulfur No. 1 Heating Oil for the Fairbanks PM-2.5 Serious Nonattainment Area

February 2019

Prepared by

The Alaska Department of Environmental Conservation Economist in collaboration with the University of Alaska Fairbanks Master of Science Program in Resource and Applied Economics.

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Abbreviations

ADEC	Alaska Department of Environmental Conservation
BACM	Best Available Control Measure
BTU	British Thermal Unit
EIA	US Energy Information Agency
EPA	US Environmental Protection Agency
FNSB	Fairbanks North Star Borough
HS	High Sulfur
NPV	Net Present Value
OPIS	Oil Price Information Service
PM	Particulate Matter
PSI	Petro Star, Inc.
SIP	State Implementation Plan
ULS	Ultra-Low Sulfur

Executive Summary

In September 2017, the Alaska Department of Environmental Conservation (ADEC) Division of Air Quality requested the ADEC Economist to facilitate a research project regarding the evaluation of possible economic impacts of a potential PM-2.5 pollution control policy mandating a transition to ultra-low sulfur (ULS) heating oil in the Fairbanks PM-2.5 Serious Nonattainment Area. The ADEC Economist worked on this research together with the University of Alaska, Fairbanks Master of Science Resource and Applied Economics Program Director and graduate students. The initial report was released in March 2018 and evaluated the possible changes in home heating fuel expenditures for Fairbanks residents given a hypothetical requirement imposing a transition to ULS heating fuel.

Upon receiving feedback on the March 2018 draft, this report has been updated to address the comments received from the public and the United States Environmental Protection Agency (EPA). In July 2018, the ADEC purchased new data to update the fuel prices used in the analysis. In the fall of 2018, additional policy analysis of a potential high sulfur (HS) No. 1 heating oil mandate was completed. This content has been added to provide information on the expenditure effects of a HS No. 1 use requirement for a typical Fairbanks household. A summary of the energy content of each fuel type, and a discussion regarding sulfur reduction and its effect on energy (BTU) content is included in *Section II.* This updated final report is the outcome of the research conducted by ADEC and the University of Alaska Fairbanks.

Below is a summary of key findings from each section of the analysis.

Section I: Fuel Costs

Important findings from the review of the incremental ULS price differentials[1], the additional cost to purchase ULS over HS, for both Anchorage and Fairbanks wholesale markets, as well as purchasing Fairbanks HS No. 1 over HS No. 2 include:

- Since 2008-2010, the ULS price differential in Alaska has decreased significantly.
- From April 2017 to July 2018[2] the ULS No. 1 to HS No. 1 monthly price differentials for Anchorage range from 3 to 42 cents/gallon.
- The average ULS No. 1 to HS No. 1 price differential for Anchorage is 23 cents/gallon, representing an 11% price increase.
- Fairbanks ULS is more expensive than Anchorage, reflecting additional transport costs.
- The ULS No. 1 to HS No. 1 monthly price differentials for Fairbanks range from 16 to 54 cents/gallon over the 16 months evaluated.
- The average ULS No. 1 to HS No. 1 price differential for Fairbanks is 34 cents/gallon, representing a 15% increase.
- In Fairbanks, there is a larger ULS price differential between ULS No. 1 to HS No. 2 than ULS No. 1 to HS No. 1, as HS No. 2 tends to be cheaper relative HS No. 1.

[1] All price differentials are listed in the summary have rounded to the nearest cent.
[2] This is the 16-month time frame evaluated. All 16-month average figures listed are calculated using OPIS price data from April 2017 through July 2018.

- The average Fairbanks HS No. 1 to HS No. 2 price differential ranges from 5 to 10 cents/gallon using a 16-month time-period.
- The ULS No. 1 to HS No. 2 monthly price differentials for Fairbanks range from 21 to 59 cents/gallon over the 16 months evaluated.
- The average ULS No. 1 to HS No. 2 price differential for Fairbanks is 41 cents/gallon, representing a 19% increase.

Section II: Household Expenditure Cost Scenarios Analysis

Important findings from the analysis of how a hypothetical shift to more expensive ULS or HS No. 1 fuel would affect household heating expenditures for Fairbanks residential households include:

- Based on the survey data collected from 2011-2015, approximately 80% of respondent households reported having a central oil heating appliance in the household.[3]
- 40% of surveyed households reported using a central oil heating appliance with no other reported appliances. Households using a central oil boiler with no other appliances reported using an average of 1,230 gallons of fuel oil.[4]
- This analysis is on the short run effects of HS to ULS, and the HS No. 2 to HS No. 1 fuel transition, highlighting the price insensitivity of household heating for FNSB residents compared to long run effects.
- Price differentials of 34 and 41 cents/gallon were used to represent the difference between HS and ULS fuel prices.
- A price differential of 7 cents/gallon is used to represent the difference between Fairbanks HS No. 1 and HS No. 2 fuel prices.
- Average household expenditures on heating energy is $2,274 annually.[5]
- Using price differentials of 34 and 41 cents/gallon, an average annual fuel usage of 1,230[6] - 50% of FNSB households would see an expected expenditure increase of $311.96 or $374.86, respectively for the first year of a shift to ULS fuel.[7]
- Estimates represent a 14% to 17% increase in household heating expenditures in the first year.
- Using a price differential of 7 cents/gallon, - 50% of households would see an expected expenditure increase of $68.31 for the first year of a switch to HS No. 1.
- This estimate represents a 3% increase in household heating expenditures in the first year.
- ULS Monte Carlo Analysis results, using a constant fuel price of $2.10, estimate that the average annual increase in household heating expenditure is $329.73.

[3] (Sierra Research Inc., 2015)
[4] (Sierra Research Inc., 2015)
[5] Section 2.2 Heating Oil Cost Models
[6] Fuel usage for central oil only homes is 1,230 gallons annually
[7] Assumed own-price elasticity of -0.2 is used for all modeled scenarios. The assumed rate of -0.2% is drawn from a study of home heating fuel demand conducted by Hirst, Goeltz, & Carney (1982) and implies that a 1% increase in the price of home heating oil will decrease the quantity demanded by 0.2%.

- This ULS Monte Carlo estimate represents a 15% increase in household expenditures in the first year.
- Based on the distribution of the Monte Carlo estimates, 90% of households are predicted to incur additional expenditures of $650 or less in the first year given a switch to ULS.
- HS No. 1 Monte Carlo Analysis results, using a constant fuel price of $2.10, estimate the average annual increase in household heating expenditure is $84.32.
- This HS No. 1 Monte Carlo estimate represents a 4% increase in household heating expenditures in the first year.
- Based on the distribution of the Monte Carlo estimates, 90% of households are predicted to incur additional expenditures of $160 or less in the first year given a switch to HS No. 1.
- ULS Monte Carlo results verify the estimates of an expected expenditure increase of $311.96 or $374.86, respectively, for the first year as the mean estimations fall within this range.
- HS No. 1 Monte Carlo results fall slightly outside the expenditure increase estimate with a mean calculated expected expenditure increase of $84.32, the median estimates are closer to the original estimate of $68.31 with an expected annual expenditure increase of $76.12.

Introduction

In December of 2009, the EPA designated Fairbanks as a Serious Nonattainment Area for Particulate Matter (PM)-2.5 emissions for the 2006 24-hour air quality standards. The Fairbanks North Star Borough (FNSB) has recorded some of the highest levels of PM-2.5 in the United States. The largest contributors to PM-2.5 in the FNSB are wood stoves and hydronic heaters.[8] Currently, two of the measures implemented to mitigate PM-2.5 emissions are requiring a removal of inefficient wood heating devices when a property is sold or leased[9] and requiring commercial wood sellers to register with the state and report the moisture content of wood they are selling to residential wood-burners.[10]

When EPA reclassified the Fairbanks PM-2.5 Nonattainment Area from a Moderate to Serious designation, it prompted the requirement for ADEC to conduct a Best Available Control Measure (BACM) analysis. The BACM analysis looks at control measures implemented throughout the United States in State Implementation Plans to control PM-2.5. This analysis was conducted as a part of the BACM process. This report provides information on potential changes in residential home heating expenditures in the Fairbanks PM-2.5 Nonattainment Area given hypothetical requirements to switch to different types of heating oil. *Section I* evaluates the fuel cost difference between ultra-low sulfur (ULS) and current heating fuels – high sulfur (HS) No. 1 or No. 2 – and the cost difference between HS No. 1 and HS No. 2. *Section II* assesses how price differences found between fuels would affect household heating expenditures for the typical FNSB household.

This report presents two evaluations of possible changes to household expenditures, the first which may arise from a conversion to ULS heating oil, and the second from HS No. 2 to HS No. 1. The analysis does not address any potential changes in household preferences and behaviors regarding home heating, nor does the assessment address other economic impacts which may arise from possible transition.[11] The modeled scenarios developed for *Section II* to determine potential changes to fuel price expenditures may be adapted to address other questions regarding direct fuel cost expenditure impacts to FNSB households. This model is an additional tool outside of this report and can be adapted to evaluate alternative price differentials, fuel usage quantities, and price elasticities.

[8] (U.S. Environmental Protection Agency, n.d.)
[9] Alaska State regulation. 18 AAC 50.077 and 18 AAC 50.079
[10] Alaska State regulation. 18 AAC 50.076(d)
[11] See Section 2.4 the Potential Benefits of a Switch to ULS for a further discussion of the potential benefits not captured in this expenditure analysis.

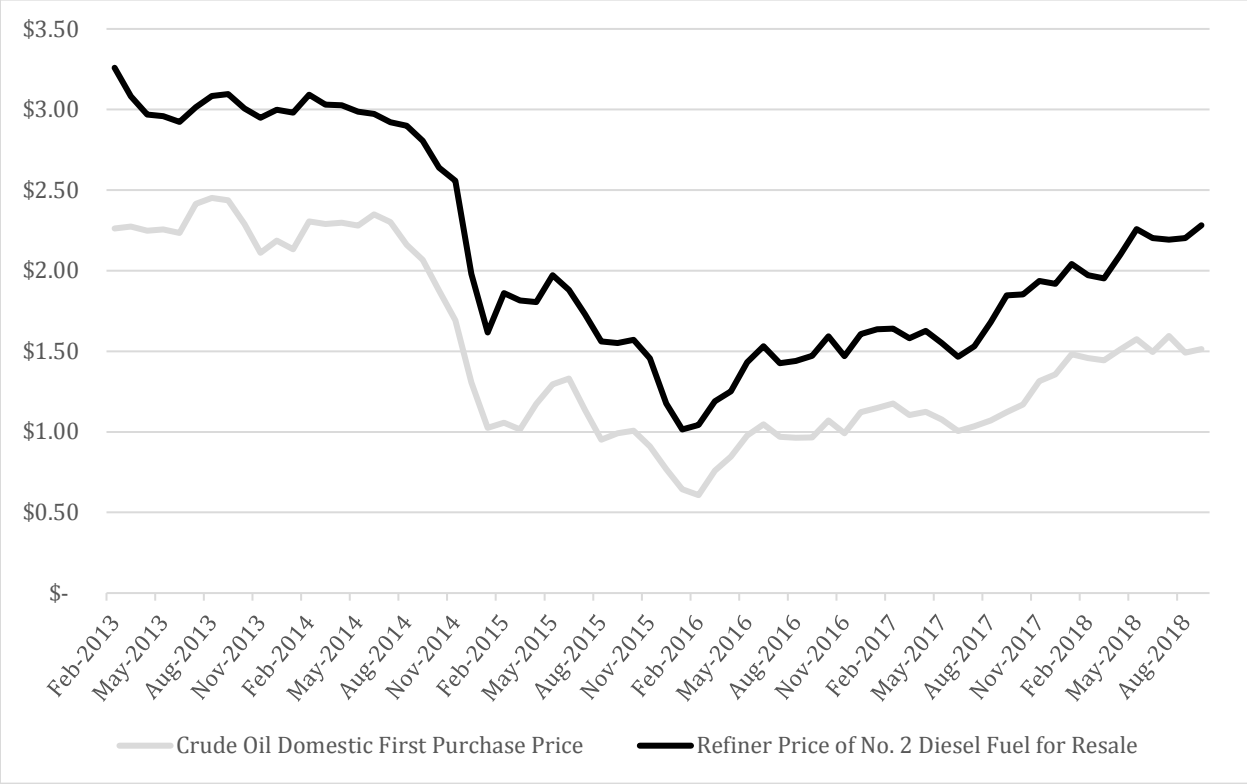
Section I: Fuel Costs

The purpose of this section is to estimate the cost effect of switching to ultra-low sulfur (ULS) heating oil, or to high sulfur (HS) No. 1 in the Fairbanks PM-2.5 Nonattainment Area. Estimates of the incremental price differences between the proposed ULS No. 1 and heating fuel products currently used, HS No. 1 and HS No. 2 are provided. These estimates were calculated by analyzing the Oil Price Information Service (OPIS) data to determine fuel cost differentials.

1.1 Fuel Cost Overview

Prior to the examination of ULS and Fairbanks HS No. 1 fuel prices, it is beneficial to review current distillate fuel price structures. The price of refined distillate fuels generally follows the price of crude oil, which is driven by the global market, weather, transportation, geopolitical, and economic factors. *Figure 1* provides a comparison of Crude Oil and Retail Diesel No. 2. This comparison depicts the price relationship between crude and refined fuels.

Figure 1: Crude Oil and Refined Diesel Prices, Dollars per Gallon



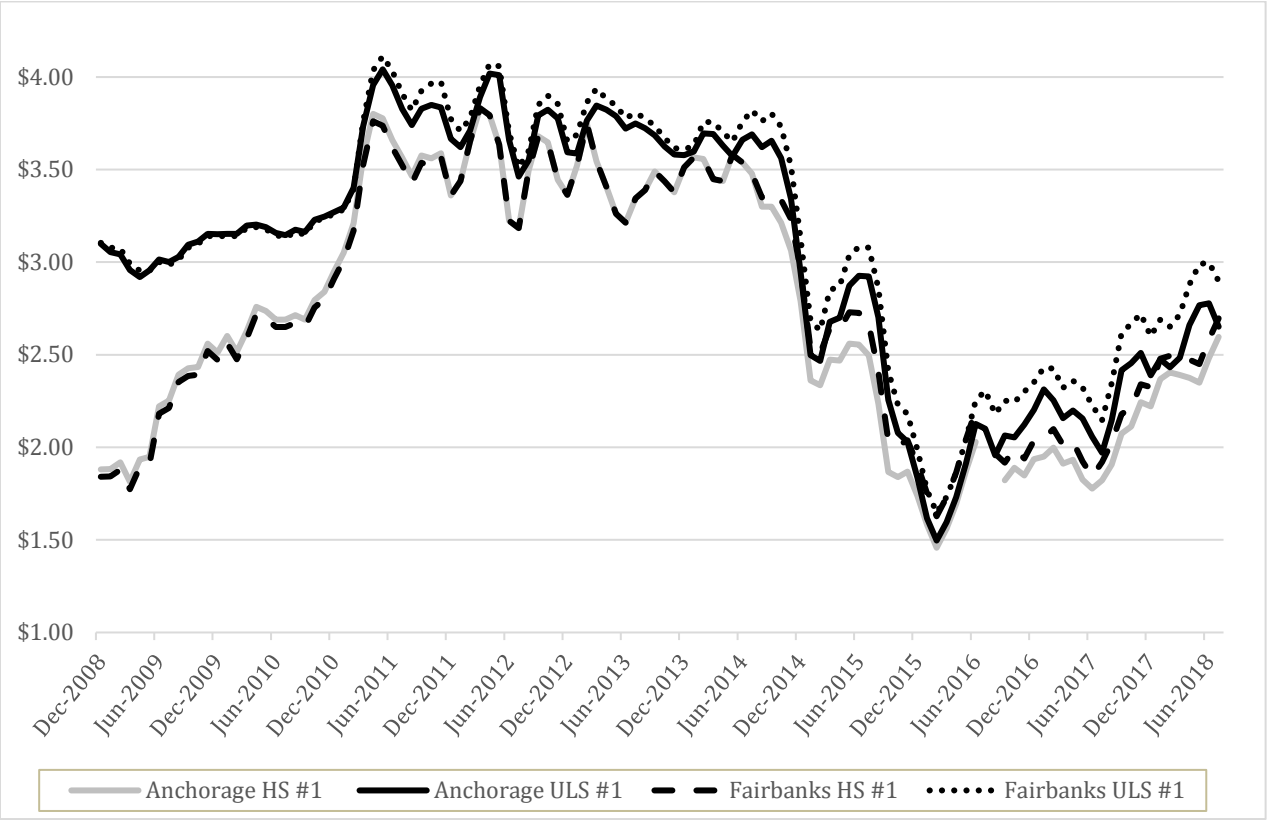
Source: Energy Information Administration (EIA), Energy Prices, September 2018[12]

[12] (EIA,2018) Crude Oil Prices "Crude Oil Domestic First Purchase Price" and (EIA,2018) "Refiner Price of No. 2 Diesel Fuel for Resale"

In recent years, there has been a significant drop in crude oil prices. This can be viewed holistically as a change in the global market influenced by a large-scale increase of US shale production (Institute for Energy Research, 2016).

Alaska is an isolated market with only five local refineries (two of which are in Prudhoe Bay and supply fuel for crude oil drilling operations). Even as prices for refined distillate fuels and heating fuels have fallen, in Alaska these prices are consistently above the national average. In addition, fuel prices are higher in Fairbanks than in Anchorage as fuel needs additional shipping to get to its destination (Northern Economics, 2007. p.15).

Figure 2: Alaska Fuel Price Comparison, Dollars per Gallon



Source: Alaska Department of Environmental Conservation, OPIS

Figure 2 presents the price of HS No. 1 in Anchorage, ULS No. 1 in Anchorage, HS No. 1 in Fairbanks, and ULS No. 1 in Fairbanks. These prices follow national market trends and reflect the price of crude oil. As a result, fuel prices in recent years are significantly lower than the 2011-2014 period.

One notable exception in Alaska is that the ULS Price Differential, the additional premium to purchase ULS over HS, has decreased significantly since 2008-2010. This can likely be attributed to increased ULS capacity, as new ULS capacity came online from Alaskan refineries. Beginning in 2008, Petro Star Inc. (PSI) invested $200 million to produce ULS at their Valdez

refinery. In 2007, Andeavor (formerly known as Tesoro) invested $63 million and from 2010-2014 an additional $189 million to manufacture ULS fuel (Econ One Research, Inc., 2015. p.3). In Fairbanks, ULS tends to be more expensive than Anchorage, which may be explained by additional transportation costs. Section 1.2 and 1.3 will explore the actual observed price differences in Fairbanks rack fuel prices over time and product type.

1.1.1 OPIS Fuel Price Data

The data reviewed consists of monthly non-weighted calendar day averages gathered by the Oil Price Information Service (OPIS). OPIS is the only provider of spot, rack, and retail prices for the United States. OPIS is known for having a defined methodology for the collection of fuel price data. Rack price data used represents market wholesale terminal prices (OPIS, 2018).

This analysis focuses on Fairbanks rack fuel prices unless otherwise noted. The data are evaluated in a static manner. Historical market prices are reviewed to estimate the incremental cost difference between fuel types.

All prices are listed in nominal terms and have not been adjusted for inflation. This price data does not include costs associated with taxes or final transportation from the wholesale terminal to the final user. A benefit of using OPIS data is that it represents the market price. The market price in economics is the price at which an asset is bought or sold. Utilization of this type of price data helps reflect the actual market price, which adds to the credibility of the price differential estimates presented.

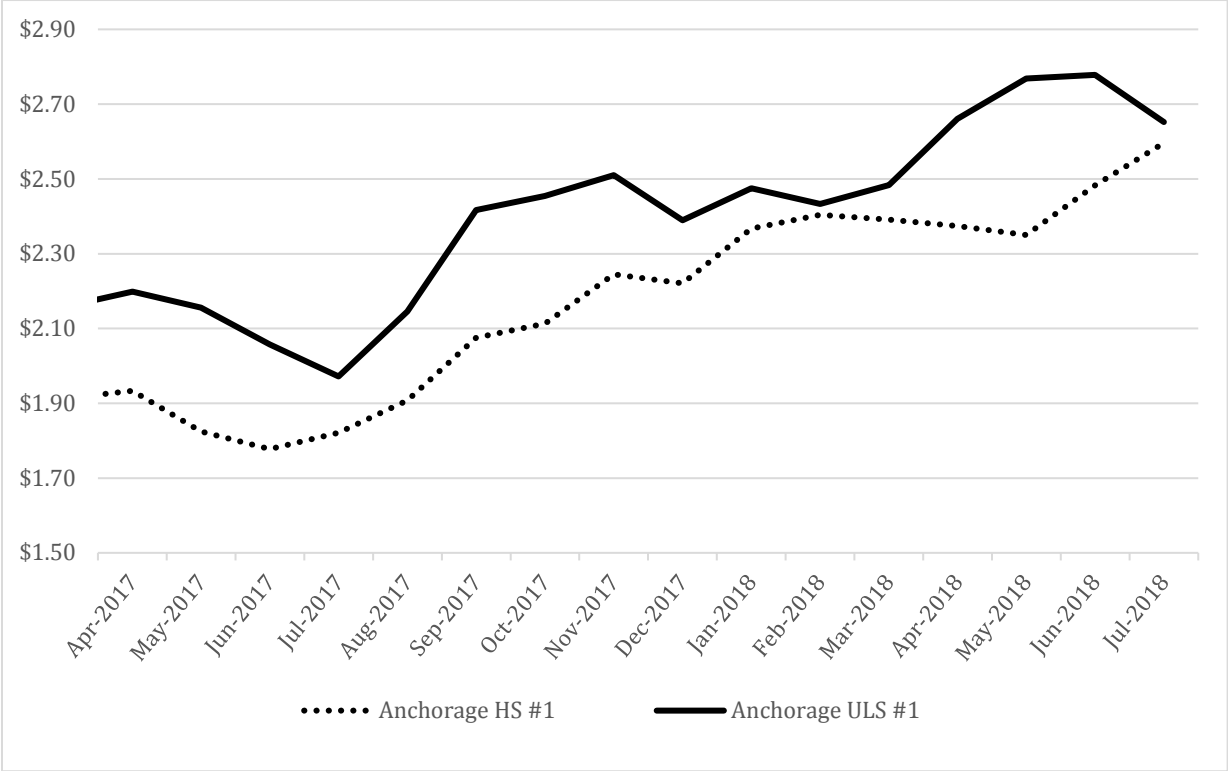
1.2 Fuel Cost Trends and Differentials

To develop estimates of the price difference between fuel types, a review of current pricing was conducted. The focus is a comparison of HS to ULS fuel prices and also a comparison of HS No. 2 to HS No. 1, as the hypothetical policy changes evaluated would require a transition to a fuel type that would fulfill EPA's sulfur content requirements for a PM-2.5 control measure. The purpose of this is to understand the cost difference between fuel types to gauge the potential fiscal impact on Fairbanks' households. A review of Anchorage prices is provided as background information should the purchase of Anchorage fuel and rail transport to Fairbanks be necessary.

Price data was evaluated by taking the non-weighted monthly average prices for Anchorage and Fairbanks, then calculating the price differentials between ULS and HS for each location. First, the fuel price differential between ULS No. 1 and HS No. 1 for Anchorage (*Table 1*) is detailed followed by the Fairbanks differentials. For Fairbanks, the price differential between both ULS No. 1 and HS No. 1 (*Table 2*), ULS No. 1 and HS No. 2 (*Table 3*), and HS No. 1 and HS No. 2 (*Table 4)* have been computed.[13]

[13] For the purpose of this analysis the fuel price differentials evaluated are individual fuel type price comparisons. There are uncertainties in the actual amount of mixed HS and ULS fuel in the heating oil products that are

Figure 3: Anchorage Distillate Cost Comparison, Dollars per Gallon



Source: Alaska Department of Environmental Conservation, OPIS

Figure 3 provides a visual representation of wholesale rack fuel prices in Anchorage over the past 16 months. As expected, there is a premium for ULS fuel. ULS production in Alaska is limited and requires additional resources to produce (Econ One Research, Inc., 2015).

distributed and sold in the Fairbanks area due to fuel blending. The strategy used here focuses on a low (HS No. 1) and a high (HS No. 2) fuel price differential estimate for Fairbanks. Situations where fuel type blending occurs would fall into a differential between the two estimated ULS Fairbanks differentials calculated here.

Table 1: Anchorage Rack Pricing Differential per Gallon HS No. 1[14]

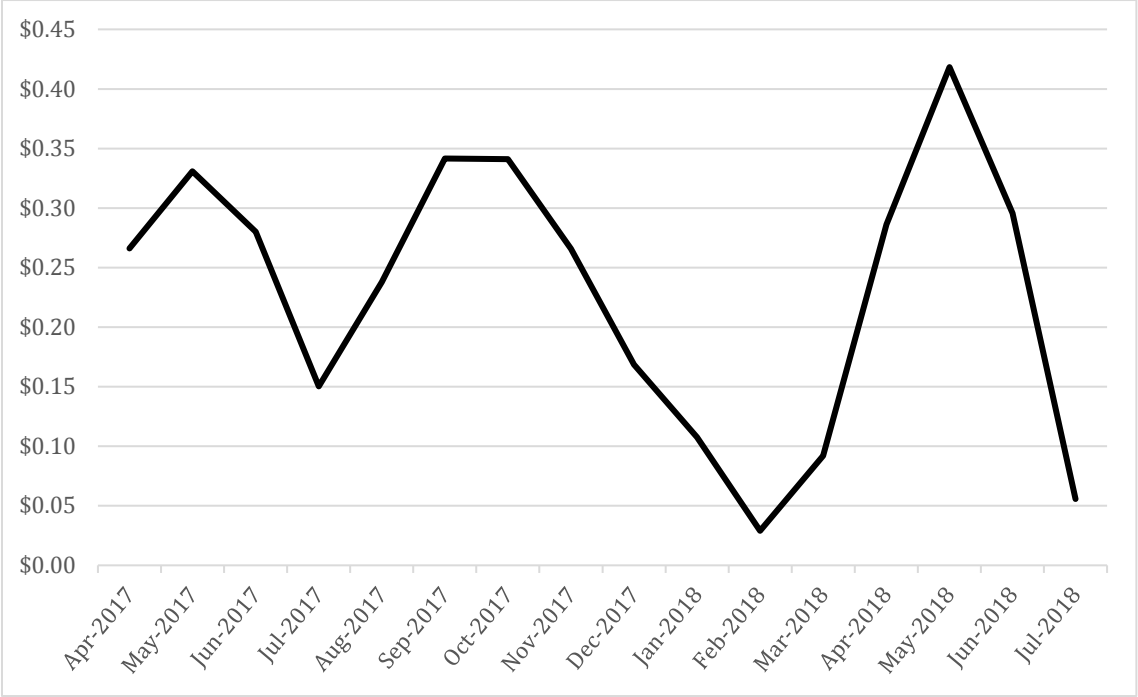
Month	ULS No. 1	HS No. 1	Price Spread ($)	Price Increase (%)
Apr-2017	2.20	1.93	0.27	13.99
May-2017	2.16	1.83	0.33	18.03
Jun-2017	2.06	1.78	0.28	15.73
Jul-2017	1.97	1.82	0.15	8.24
Aug-2017	2.15	1.91	0.24	12.57
Sep-2017	2.42	2.08	0.34	16.35
Oct-2017	2.45	2.11	0.34	16.11
Nov-2017	2.51	2.25	0.26	11.56
Dec-2017	2.39	2.22	0.17	7.66
Jan-2018	2.48	2.37	0.11	4.64
Feb-2018	2.43	2.40	0.03	1.25
Mar-2018	2.48	2.39	0.09	3.77
Apr-2018	2.66	2.37	0.29	12.24
May-2018	2.77	2.35	0.42	17.87
Jun-2018	2.78	2.48	0.30	12.10
Jul-2018	2.65	2.60	0.05	1.92
16 Month Average	**2.41**	**2.18**	**0.23**	**10.55**

Source: Alaska Department of Environmental Conservation, OPIS

Table 1 provides Anchorage price differentials by month for ULS No. 1 in comparison to HS No. 1. From April 2017 to July 2018, the 16-month average fuel price differential is 23 cents/gallon. This represents an average price differential of 10.55%. The average monthly ULS No. 1 price differential for during this time frame ranges from 3 – 42 cents/gallon.

[14] For presentation purposes all figures in each Differential Table have been rounded to two decimal points. This rounding will account for slight differences from of averages computed directly from raw OPIS data.

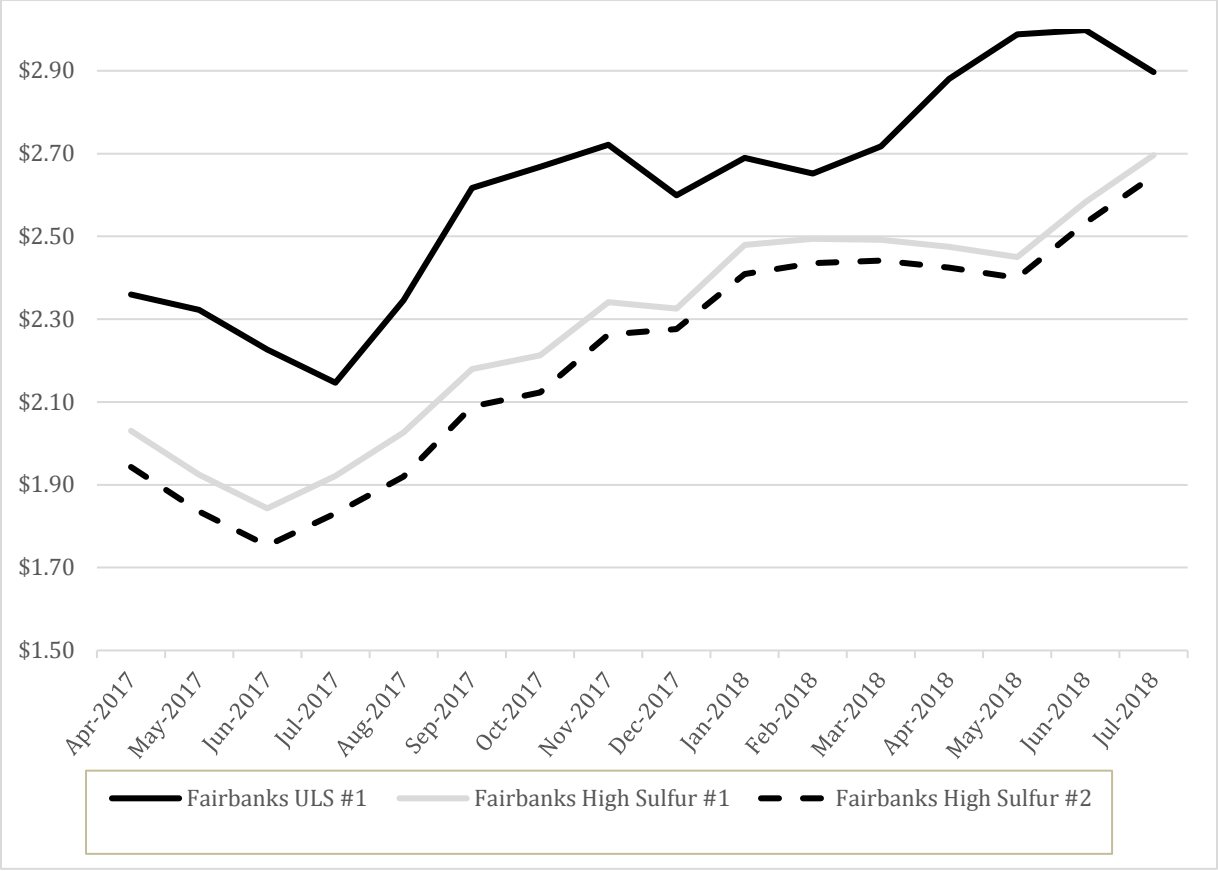
Figure 4: Anchorage Price Differential ULS No. 1 and HS No. 1, Dollars per Gallon



Source: Alaska Department of Environmental Conservation, OPIS

Figure 4 depicts the fuel price differential (detailed in *Table 1*) for the Anchorage wholesale market. Price differences range from a low of 3 cents/gallon to a high of 42 cents/gallon with a 16-month average differential of 23 cents/gallon. In 2018 the price spread increases significantly prior to dropping dramatically in July the most recent month of price data. The following set of figures and tables will explore the fuel price differential for the Fairbanks wholesale market.

Figure 5: Fairbanks Distillate Cost Comparison, Dollars per Gallon



Source: Alaska Department of Environmental Conservation, OPIS

Figure 5 presents wholesale rack fuel prices in Fairbanks over the past 16 months. As expected, there is a premium for ULS fuel. It is notable that the total price of ULS No. 1 has risen sharply since the summer of 2016. As the price difference between HS No. 1 and HS No. 2 is significant, this is taken into consideration through further analysis of each fuel type to develop specific scenarios for HS No. 1 and HS No. 2 fuel usage. The price differential between HS No. 1 and HS No. 2 is also analyzed separately.

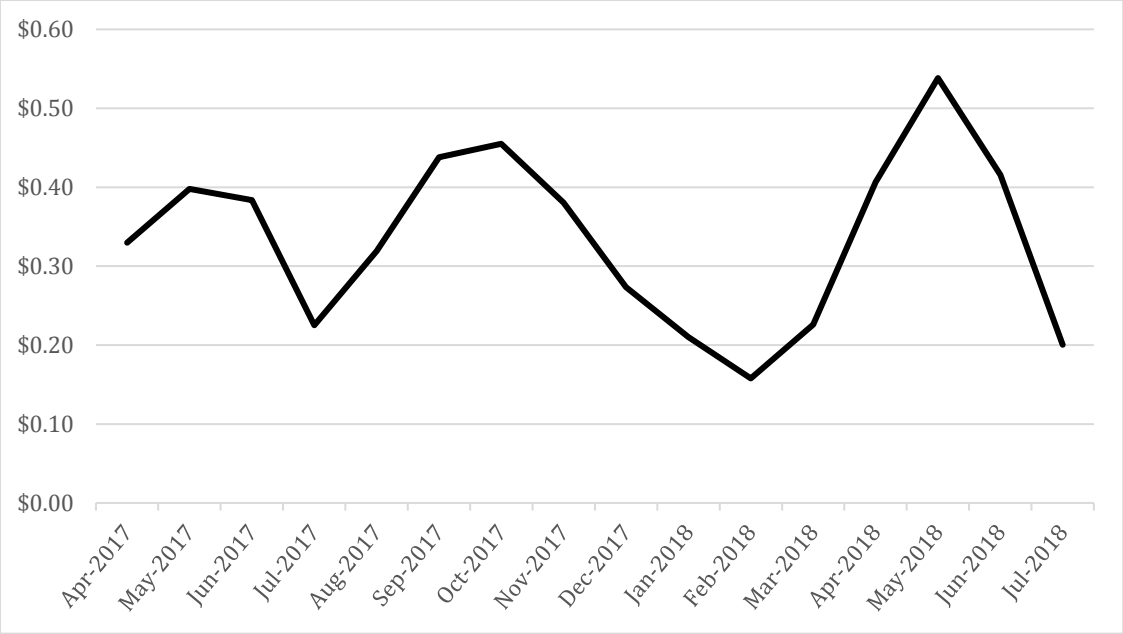
Table 2: Fairbanks Rack Pricing Differential per Gallon HS No. 1

Month	ULS No. 1	HS No. 1	Price Spread ($)	Price Increase (%)
Apr-2017	2.36	2.03	0.33	16.26
May-2017	2.32	1.93	0.39	20.21
Jun-2017	2.23	1.84	0.39	21.20
Jul-2017	2.15	1.92	0.23	11.98
Aug-2017	2.35	2.03	0.32	15.76
Sep-2017	2.62	2.18	0.44	20.18
Oct-2017	2.67	2.21	0.46	20.81
Nov-2017	2.72	2.34	0.38	16.24
Dec-2017	2.60	2.33	0.27	11.59
Jan-2018	2.69	2.48	0.21	8.47
Feb-2018	2.65	2.49	0.16	6.43
Mar-2018	2.72	2.49	0.23	9.24
Apr-2018	2.91	2.47	0.44	17.81
May-2018	2.99	2.45	0.54	22.04
Jun-2018	3.00	2.58	0.42	16.28
Jul-2018	2.90	2.70	0.20	7.41
16 Month Average	**2.62**	**2.28**	**0.34**	**15.12**

Source: Alaska Department of Environmental Conservation, OPIS

Table 2 presents Fairbanks price differentials month-by-month for ULS No. 1 in comparison to HS No. 1. From April 2017 to July 2018, the 16-month average fuel price differential is 34 cents/gallon, which represents an average premium of 15.12% for ULS No. 1 over HS No. 1. The average monthly ULS No. 1 price differential during this time frame ranges between 16 – 54 cents/gallon.

Figure 6: Fairbanks Price Differential ULS No. 1 and HS No. 1, Dollars per Gallon



Source: Alaska Department of Environmental Conservation, OPIS

Figure 6 presents the price differential of ULS No. 1 to HS No. 1 (detailed in *Table 2*) for the Fairbanks wholesale market. Price differences over the last 16-months range from a low of 16 cents/gallon to a high of 54 cents/gallon with an average difference of 34 cents/gallon.

Table 3: Fairbanks Rack Pricing Differential per Gallon HS No. 2

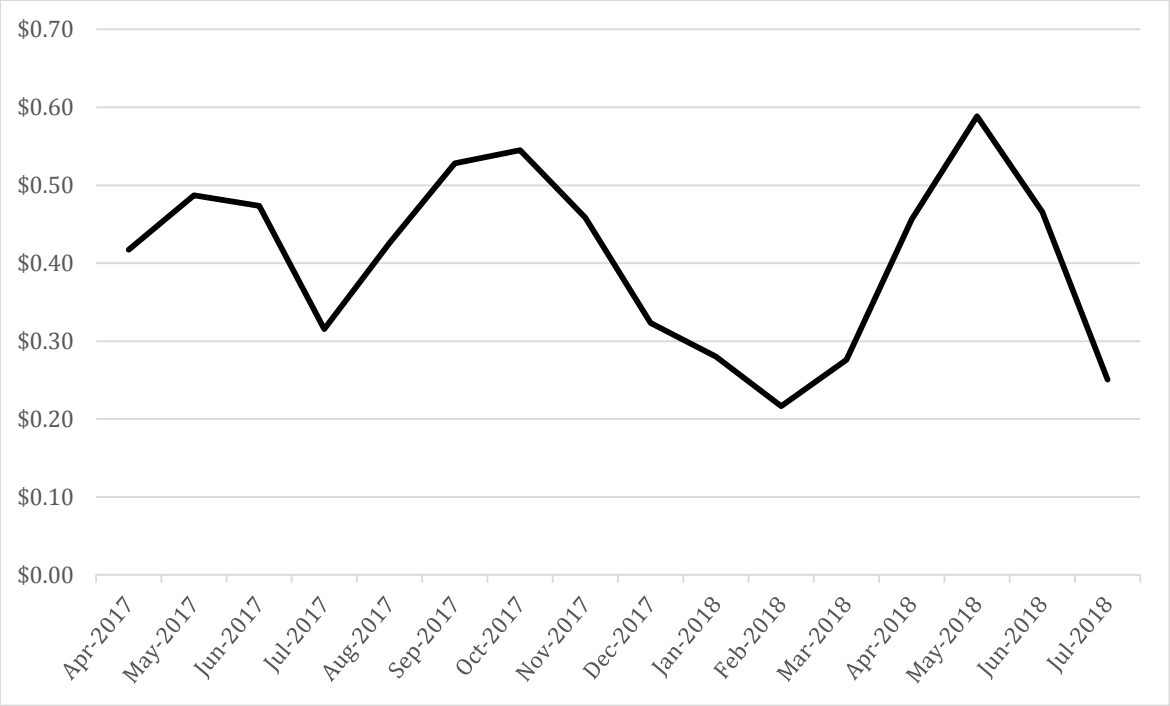
Month	ULS No.1	HS No. 2	Price Spread ($)	Price Increase (%)
Apr-2017	2.36	1.94	0.42	21.65
May-2017	2.32	1.84	0.48	26.09
Jun-2017	2.23	1.75	0.48	27.43
Jul-2017	2.15	1.83	0.32	17.49
Aug-2017	2.35	1.92	0.43	22.40
Sep-2017	2.62	2.09	0.53	25.36
Oct-2017	2.67	2.12	0.55	25.94
Nov-2017	2.72	2.26	0.46	20.35
Dec-2017	2.60	2.28	0.32	14.04
Jan-2018	2.69	2.41	0.28	11.62
Feb-2018	2.65	2.44	0.21	8.61
Mar-2018	2.72	2.44	0.28	11.48
Apr-2018	2.91	2.42	0.49	20.25
May-2018	2.99	2.40	0.59	24.58
Jun-2018	3.00	2.53	0.47	18.58
Jul-2018	2.90	2.65	0.25	9.43
16 Month Average	**2.62**	**2.21**	**0.41**	**18.55**

Source: Alaska Department of Environmental Conservation, OPIS

Table 3 provides Fairbanks price differentials by month for ULS No. 1 in comparison to HS No. 2. HS No. 2 is also used for residential heating oil in Fairbanks, and due to its lower price has the largest differentials.

The fuel price differentials, from April 2017 through July 2018 range from 21 to 59 cents/gallon. This results in a 16-month average price differential for ULS No. 1 in comparison to HS No. 2 in Fairbanks of 41 cents/gallon which represents an average premium of 18.55%.

Figure 7: Fairbanks Price Differential ULS No. 1 and HS No. 2, Dollars per Gallon



Source: Alaska Department of Environmental Conservation, OPIS

Figure 7 depicts ULS No. 1 over HS No. 2 fuel price differential (from *Table 3*) for the Fairbanks wholesale market. It is important to note that of all the fuel price differentials examined in this analysis, that ULS No. 1 over HS No. 2 for Fairbanks has the least amount of variance. While there still are month-to-month fluctuations the price premium has consistently been 22 cents/gallon or higher with 12 months being 30 cents/gallon or higher.

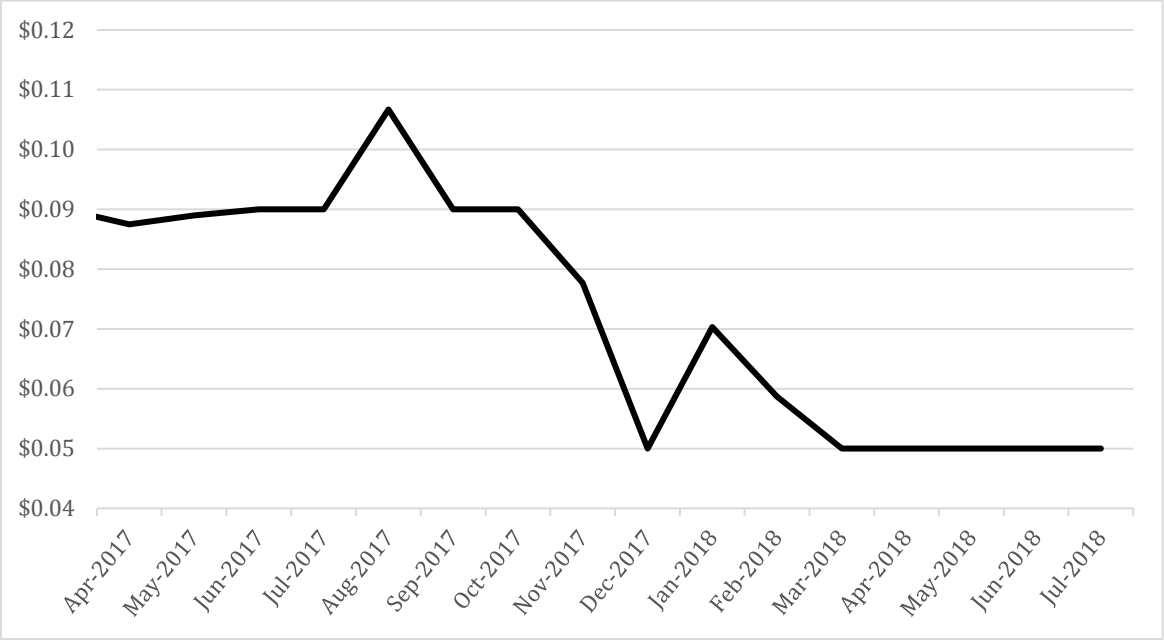
Table 4: Fairbanks Rack Pricing Differential per Gallon HS No. 1 and HS No. 2

Month	HS No. 1	HS No. 2	Price Spread ($)	Price Increase (%)
Apr-2017	2.03	1.94	0.09	4.64
May-2017	1.93	1.84	0.09	4.89
Jun-2017	1.84	1.75	0.09	5.14
Jul-2017	1.92	1.83	0.09	4.92
Aug-2017	2.03	1.92	0.11	5.73
Sep-2017	2.18	2.09	0.09	4.31
Oct-2017	2.21	2.12	0.09	4.25
Nov-2017	2.34	2.26	0.08	3.54
Dec-2017	2.33	2.28	0.05	2.19
Jan-2018	2.48	2.41	0.07	2.90
Feb-2018	2.49	2.44	0.05	2.05
Mar-2018	2.49	2.44	0.05	2.05
Apr-2018	2.47	2.42	0.05	2.07
May-2018	2.45	2.40	0.05	2.08
Jun-2018	2.58	2.53	0.05	1.98
Jul-2018	2.70	2.65	0.05	1.89
16-Month Average	**2.28**	**2.21**	**0.07**	**3.17**

Source: Alaska Department of Environmental Conservation, OPIS

Table 4 provides Fairbanks price differentials by month for HS No. 2 in comparison to HS No. 1. The fuel price differentials, from April 2017 through July 2018 range from 5 to 11 cents/gallon. This results in a 16-month average price differential for HS No. 2 in comparison to HS No. 1 in Fairbanks of 7 cents/gallon which represents an average premium of 3.17%.

Figure 8: Fairbanks Price Differential HS No. 2 and HS No. 1



Source: Alaska Department of Environmental Conservation, OPIS

Figure 8 depicts the fuel price differential (detailed in *Table 3*) for Fairbanks HS No. 2 and HS No. 1 wholesale market. Price differences range from a low of 5 cents/gallon to a high of 10 cents/gallon with a 16-month average differential of 7 cents/gallon. From August 2017 to March 2018 the price differential decreases significantly.

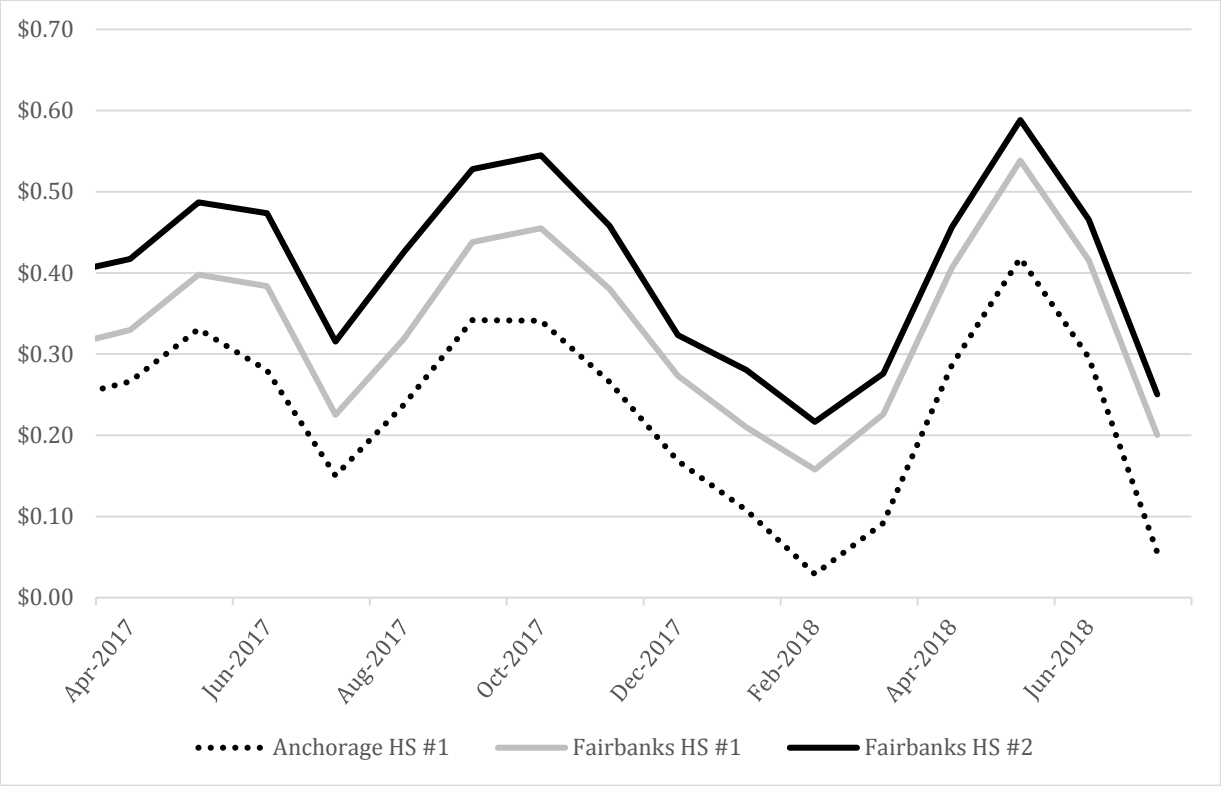
1.3 Fuel Differentials Summary

The incremental cost difference between HS and ULS, and between Fairbanks HS No. 1 and HS No. 2 heating fuel is important to review. A hypothetical change in fuel demand may induce further economic impacts and additional costs to households. The previous section reviewed the price differential of a potential shift from HS products to ULS No. 1, and Fairbanks HS No. 1 to HS No. 2 for individual rack fuels. In this section, a comprehensive examination of these differentials is provided.

These differentials indicate one of the cost impacts that hypothetical heating fuel requirements could have on Fairbanks. *Figure 8* includes ULS No. 1 fuel price differentials between Anchorage HS No. 1, Fairbanks HS No. 1 and Fairbanks HS No. 2.[15] *Figure 9* below includes the price differential between Fairbanks HS No. 1 and HS No. 2.

[15] Anacortes fuel prices were provided in the OPIS data, but are not evaluated, as there is no data to compute a ULS/HS differential (our current OPIS dataset indicates that Anacortes does not supply HS fuel). Northern Economics, found in previous work that reviewed 2006 and 2007 OPIS data from indicated that the Northwest area had a very small ULS price differential of about 1.5%. (Northern, 2007. p.57)

Figure 9: Alaska ULS No. 1 Price Differentials, Dollars per Gallon



Source: Alaska Department of Environmental Conservation, OPIS

The data in *Figure 9* indicates that the price differential between HS and ULS No. 1 ranges from 3 cents/gallon in Anchorage during February 2018, to 59 cents/gallon in Fairbanks during May 2018. The price differential between HS and ULS No. 1 fuel is significantly higher for Fairbanks than Anchorage. An explanation for this trend was provided by Northern Economics in their 2007 report: Cost Assessment for Diesel Fuel Transition in Western and Northern Alaska Communities, which states a key driver as, *"all ULS products are shipped by rail from Anchorage to Fairbanks, while the HS product is obtained from local refiners. The result is an average pricing premium…"*[16]

Additional fuel transportation logistics result in higher price premiums in the Fairbanks wholesale market. Anchorage fuel can be stored at Ship Creek where it then goes up the Alaska Railroad to Fairbanks. The latest publicly available information on the cost to ship fuel to Anchorage, from the Andeavor refinery in Kenai, is approximately 2 cents/gallon while the rail costs between Anchorage and Fairbanks is approximately 16 cents/gallon (Econ One Research, Inc., 2015, p.10). This study also estimated the cost of transport for ULS fuel from PSI's Valdez refinery to Fairbanks at approximately 20 cents/gallon (Econ One Research, Inc., 2015, p.25).

The fuel price differentials are reviewed here with the goal of developing an estimate of the direct expenditure impact to Fairbanks households. Information limitations result in an absence

[16] (Northern, 2007. p.56)

in evaluation of any potential added supplier capital costs to ship additional quantities of ULS and or HS No. 1 to Fairbanks. It is likely that, if these costs were to occur, they would be passed to the consumer. This analysis does not evaluate the effect of economies of scale with increased product demand or the potential for third party fuel distributors to enter the market to ship imported heating oil to Fairbanks and undercut competitors' prices. If these effects occurred, it is likely that this would result in no price increase or a potential for a price decrease for consumers. It is hard to predict which of these phenomena would occur and whether they would occur simultaneously. Though these factors are not analyzed in this review and beyond the scope of this study, ADEC recognizes that these factors are still important when analyzing the economic impacts of shifting to ULS heating fuel.

1.4 Fuel Cost Conclusions

Findings show through review of Fairbanks price data from April 2017 to July 2018, an average 34 cents/gallon for ULS over HS No. 1 and an average 41 cents/gallon premium for ULS over HS No. 2. Respectively, a shift from HS No. 1 to ULS No. 1 would result in a price increase of approximately 15%. While a shift from HS No. 2 to ULS No. 1 would result in a price increase of approximately 19%. A shift from HS No. 2 to HS No. 1 results in an average price differential of 7 cents/gallon, which represents an increase of approximately 3%. These price increases would directly affect household heating expenditures for fuel oil and are used in *Section II* to support the cost analysis.

Section II: Household Expenditure Scenarios Analysis

This section provides information on a cost model to explain potential changes in residential home heating expenditures assuming a switch to ultra-low sulfur (ULS) or shift from HS No. 2 to HS No. 1 heating fuel in the Fairbanks PM-2.5 Nonattainment Area. This section further employs a Monte Carlo analysis of the change in household heating oil expenditures from a switch to ULS, and a switch to HS No. 1. The objective of the Monte Carlo analysis is to help predict the expected change in household heating expenditures given a range of price differentials, annual household fuel consumption, and elasticity of demand estimates.

This assessment does not address the economic impact of both hypothetical heating fuel policy mandates, nor does it address the relative costs and benefits associated with conversion. Additional costs may include changes in fuel storage and distribution, whereas additional benefits would include improvements in air quality and reduced boiler maintenance. There is no assumed efficiency difference or boiler maintenance costs between HS No. 1 and HS No. 2. A switch to ULS or HS No. 1 may also produce behavioral responses by households which impact heating fuel demand in both the short and long run. It is important to note that the models do not take these issues into account and therefore results are only estimates based on the best information available at the time of publication.

2.1 Household Heating Oil Expenditure Changes from ULS

A potential transition from high sulfur (HS) home heating oil to ULS fuel would result in changes to household expenditures on fuel oil. Contributing factors include: fuel price differentials, heating efficiency changes, boiler maintenance cost reduction, and changes in the quantity of fuel used due to consumer price sensitivity. To assess how a potential transition from HS to ULS fuel might change household expenditures, this analysis makes several assumptions about key contributing factors likely to influence spending. First, expenditure estimates draw on the 16-month price differentials of 34 and 41.[17] Second, the differential adjusted prices are multiplied by the quantity of fuel consumed by a typical household using only a central oil-fired boiler. Finally, existing estimates of household fuel usage were adjusted to account for an average price sensitivity factor of -0.2%.

Evidence in the literature suggests that reducing sulfur and heat content in boiler fuel have a zero net change effect on fuel consumption.[18] Additional detail about the fundamental components of the estimates as well as supporting documentation is presented in the following discussion. It should also be noted that while the expenditure calculations do not include potential changes in maintenance costs that may occur, information about the potential savings have been included.

2.1.2 Household Heating Oil Expenditure Changes from HS No. 1

A potential switch from Fairbanks HS No. 2 to HS No. 1 would result in similar changes to household expenditures on fuel oil. It should be noted that the analysis of the change in household heating oil consumption from a switch to HS No. 1 uses the same underlying assumptions as discussed in *Section 2.2.1*. Differential prices between HS No. 1 and HS No. 2 are multiplied by the quantity of fuel consumed by a typical household using only a central oil-fired boiler. Existing estimates of household fuel usage were adjusted to account for an average price sensitivity factor of -0.2%. There is no assumed efficiency or boiler maintenance costs differences between HS No. 1 and HS No. 2.

2.1.3 Household Heating Oil Consumption

The cost scenarios are based on an assumed level of annual household heating oil demand. The estimated home heating oil usage is based on the Fairbanks Home Heating Telephone Survey conducted by Sierra Research Inc. Estimates utilized data[19] from 2011-2015, of the 2,304 households surveyed, 1,910 reported fuel quantities for at least one oil burning appliance. Homes that are heated only by a central oil burner are the most common heating configuration,

[17] 34 and 41 cents/gallon are the differentials presented in *Section I*. These differentials represent the change from ULS No. 1 to HS No. 1 and HS No. 1 to No. 2 respectively. All modeling in *Section 2* uses 33 and 40 cents/gallon as inputs. These values represent the non-rounded price differences and do not significantly alter results.
[18] See Section 2.1.5 Appliance Efficiency and Maintenance Cost with ULS.
[19] A description of the data set is included in *Appendix A*.

representing about 40% of homes in the data set. On average, central oil burner FNSB homes consumed 1,230 gallons of heating fuel oil per year as shown in *Table 5* below. Household expenditures on heating energy is on average $2,274 annually for homes in the data as shown in *Table 5*. Homes with a central oil burner and a wood stove are also common in the data set, representing about 20% of households. *Table 6* contains the oil and wood consumption quantities for homes with a central oil burner/wood stove appliance combination. This analysis does not account for cross price effects of oil on other energy sources, such as firewood. Respondents were asked to estimate their annual fuel consumption (in gallons and in cost) over the phone. Fuel consumption estimates are heavily influenced by home size, heating degree days[20], and regional climate factors. These dynamics contribute to variability in responses resulting in large standard deviations for the estimates.

Table 5: Summary of Typical Annual Central Oil Only Appliance Household Consumption

	Mean	**Median**	**Observations**
Oil Usage (gal)	1230 (719)	1100	787
Home Size (sq ft)	1895 (827)	1842	787
Household Expenditures	$2274 ($2352)	$1850	787

Source: Sierra Research Inc., Fairbanks Home Heating Telephone Survey, 2011-2015
Note: Standard Deviations in parentheses

[20] Heating degree days are a common metric used to compare space heating loads or demand across locations or by month/season within a specific area. Heating degree days represent the number of degrees that that day's average temperature is below a base or reference number, typically 65° F.

Table 6: Summary of Typical Annual Central Oil Wood Stove Appliance Household Consumption[21]

	Mean	Median	Observations
Oil Usage (gal)	906 (535)	800	403
Wood Usage (cord)	3.6 (2.3)	3	403
Home Size (sq ft)	1935 (709)	1855	403

Source: Sierra Research Inc., Fairbanks Home Heating Telephone Survey, 2011-2015
Note: Standard Deviations in parentheses

2.1.4 Gross Energy Content and Emissions from Heating Fuels

Table 7: Heating Source Energy Content[22]

Fuel Type	Content (BTU)	Unit
HS No. 1 and No. 2 Blend	135,000	/gal
Natural Gas	1,010,000	/mcf
Wood, Pellet	16,000,000	/ton
Wood, Cordwood Wtd. Avg.	20,372,980	/cord
Coal, Stoker	15,200,000	/ton
Ultra-Low Sulfur Heating Oil*	134,000	/gal

* Estimated from HS Blend energy content and EIA (https://www.eia.gov/todayinenergy/detail.php?id=20092)
Source: FNSB Community Research Quarterly-Based Heating Fuel Energy Content

Table 7 presents the energy content in BTU's by heating fuel source. These are the energy content assumptions used in this analysis. Wood energy content based is on a baseline moisture content of 20% and a weighted mixture of spruce, birch, and aspen cordwood. The fuel oil energy content used is a common HS No. 1 and HS No. 2 weighted mixture of 31.8% HS No. 1 and 68.2% HS No. 2 used in Fairbanks residential space heating

[21] We are unable to calculate estimates of the additional fuel cost expenditures to these homes at this time. Additional work is being conducted to understand cross-price elasticity for households in this category.
[22] EIA's calculation of the heat content of distillate fuel supply in the United States reflects these changes, going from about 138.6 thousand British thermal units (Btu) per gallon in 1994, to an estimated 137.5 thousand Btu per gallon in 2014.

Table 8: Comparison of Key Emission Factors and Sulfur Content for Fairbanks Heating Fuels

Fuel	Emission Factor (lb/mmBTU)		Sulfur Content (ppmv)
	$PM_{2.5}$	SO_2	
HS No. 1 & 2	0.00340	0.215	2,053
HS No. 1	0.00365	0.102	896
HS No. 2	0.00330	0.263	2,566
Natural Gas	0.00749	0.000591	<16
Coal	0.526	0.612	2,000
Wood Burning	0.18 – 2.0*	0.023	<500
ULS	~0.003-0.004	0.00171	15

ppmv = parts per million by volume
* Covering a range of uncertified and EPA-certified cordwood and pellet devices, assuming zero (oven dry) moisture content
Source: compiled by Sierra Research, Inc

Table 8 summarizes emission factors per unit of fuel energy (in lb/MMBTU) to enable equivalent comparisons across the range of solid, liquid and gaseous heating fuels used in Fairbanks. Emission factors are listed for both directly-emitted $PM_{2.5}$ and SO_2 (the most significant precursor in Fairbanks). Sulfur contents of each fuel (in parts per million) are also compared. As shown in Table 8, emission factors of $PM_{2.5}$ and SO_2 vary by several orders of magnitude across the range of common heating fuels. SO_2 emission factors are generally related to sulfur content. $PM_{2.5}$ emission factors are less dependent upon sulfur content, expect within the same class of fuel (e.g., heating oil).

2.1.5 Sulfur Content Reduction and Effects on Energy Content

A misconception surrounding the sulfur content of fuels is that a reduction in sulfur content decreases the energy content (BTU's) of the distillate fuel source. Sulfur being removed from distillate fuel during the refining process is known as catalytic hydrotreating; catalytic hydrotreating strips away sulfur as well as nitrogen, oxygen, and metals from hydrocarbon compounds. These reactions reduce the weight per gallon and a small portion of the thermal energy obtained from the combustion of a gallon of distillate fuel. The Energy Information Administration's (EIA) calculation of the heat content of distillate fuel supply in the United States reflects these changes in the weight per gallon, going from about 138.6 thousand BTU's per gallon to an estimated 137.5 thousand BTU per gallon. This represents less than a 1% loss in energy content per gallon during the refining process for the removal of sulfur

2.1.6 Price Elasticity of Demand

The price elasticity of demand measures how sensitive the quantity demanded of a good or service is to a change in price.[23] The sensitivity of the quantity of heating oil consumed by a household relative to changes in fuel price depends on several factors, including: temperature preferences, heating appliance(s) type, heating appliance(s) age, home age, and overall energy efficiency of the home. Demand is said to be "inelastic" when the percentage change in quantity is less than the percentage change in price. Demand is said to be "elastic" when the percentage change in quantity is greater than the percentage change in price. Cost scenarios are evaluated using an assumed oil price elasticity of 0.2%. Using an elasticity of 0 would imply that home heating oil demand is perfectly inelastic and that any change in the price of heating oil will not alter the quantity of heating oil demanded by households. This analysis assumes a constant price elasticity of demand[24] for all levels of home heating oil demand. The assumed rate of -0.2% is drawn from a study of home heating fuel demand conducted by Hirst, Goeltz, & Carney (1982) and implies that a 1% increase in the price of home heating oil will decrease the quantity demanded by 0.2%. Demand in this case is highly inelastic.[25]

Given a price increase to heating fuel, households will be incentivized to pursue activities that decrease heating expenditures. Immediate improvements such as caulking and weather stripping can reduce home heating expenditures in the average United States household by 2.5% (Gardner, 2008). A more drastic action, such as improving insulation and eliminating drafts within a home attic space, can reduce home heating expenditures by up to 7% (Gardner, 2008) in the typical US household. More simply put, homeowners will turn down their thermostat. FNSB households will have higher expenditures on home heating than the typical households similar relative to size due to extreme weather conditions. Cost savings associated with home efficiency improvements have a larger effect on FNSB household's price sensitivity to heating fuel. Specifically, FNSB homes have a more significant decrease in their price sensitivity to heating fuel due to cost savings from efficiency improvements.[26]

2.1.7 ULS and High Sulfur Cost Differentials

Drawing on *Section I*, the cost scenarios incorporate heating fuel price differentials based on 16 months (April 2017 through July 2018) of OPIS data for Fairbanks. No assumptions are made as to whether these price differentials will increase or decrease over time, and so all modeled scenarios employ constant price differentials. As mentioned in *Section 1.5*, the average price differential for ULS and HS No. 1 and ULS and HS No. 2, are 34 and 41 cents/gallon

[23] Examples of how the price elasticity of demand is calculated are explained in *Appendix B.*
[24] See *Appendix C*
[25] This estimate is for the short run effects of the transition to ULS fuel. Long run effects are not taken into consideration in this analysis, but would have lower costs compared to the short run.
[26] A decrease in the price sensitivity to heating fuel would indicate the households demand for will become more elastic.

respectively.[27] Both ULS price differentials are presented in different scenarios, referred to as Scenario 1 for the lower price differential of 34 cents/gallon, and Scenario 2 for the higher price differential of 41 cents/gallon. The ULS price differential of 34 cents/gallon represents the change between ULS and HS No. 1. The price differential of 41 cents/gallon represents the change between ULS and HS No. 2.

2.1.8 High Sulfur No. 1 and High Sulfur No. 2 Cost Differentials

In *Section 1.5* the Fairbanks HS price differential of 7 cents/gallon is based on the 16-month (April 2017-July 2018) averages of HS No. 1 and HS No. 2. Price differentials based on historical pricing data and calculations can be found in *Table 4*. This analysis does not make assumptions regarding current fuel usage mix consumed by the typical FNSB household.

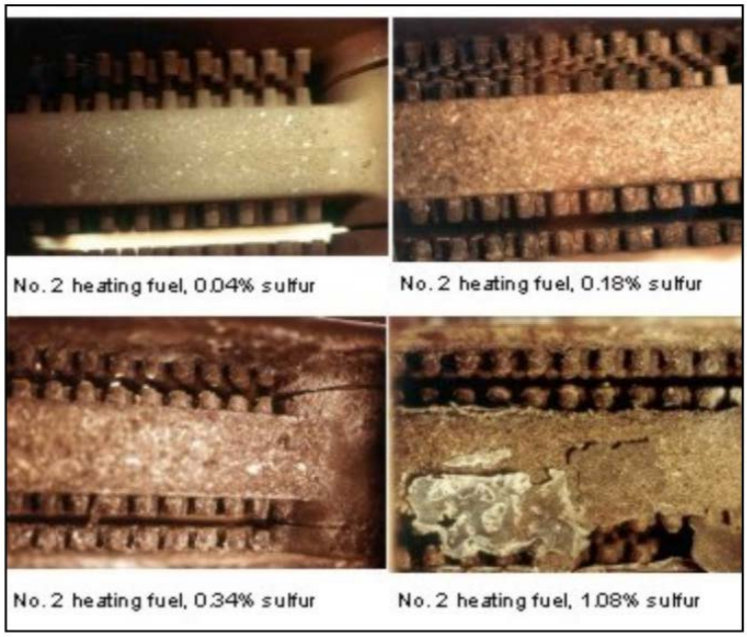
2.1.9 Appliance Efficiency and Maintenance Cost with ULS

Heat content differences in HS fuel and ULS fuel mean that more ULS fuel will need to be burned to maintain the same indoor temperatures.[28] As noted *in Section II,* there is no assumed fuel efficiency or boiler maintenance cost difference between HS No. 1 and HS No. 2; therefore, this section will focus solely on the appliance efficiency and maintenance costs associated with a hypothetical switch to ULS. Approximately 1% more ULS fuel by volume would be required to compensate for the loss in heat content over HS fuel oil (EIA, 2018). However, boilers burning ULS fuels operate at a higher level of efficiency. It is assumed that the balance of these effects results in no change to fuel quantity consumption. This analysis accounts only for changes in fuel consumption, but a brief discussion of potential maintenance and repair costs is included. An explanation of assumptions in this analysis and a relevant synopsis of two Brookhaven National Laboratory Reports (Batey & McDonald, 2007 and Batey & McDonald, 2015) are included here.

A switch from HS fuel to ULS fuel has a significant effect on boiler efficiency. Batey and McDonald, 2015 compared the rates of 'boiler fouling' in systems using conventional heating oil and ULS fuel. Decreases in boiler efficiency are caused by buildup of soot on heat exchange surfaces. As shown in *Figure 10*, soot buildup is directly related to the sulfur content of the burned fuel.

[27] Due to rounding error, all modeled scenarios are calculated using values of 33 and 40 cents/gallon for ULS to HS No. 1 and ULS to HS No. 2 price differentials respectively.
[28] Refer to *Table 7* and *Table 8* for energy content and sulfur content be fuel type

Figure 10: Buildup of Soot and Particulates on Heat Exchange Plates for Identical Boilers using Different Fuels



Source: Batey and McDonald, 2015, p. 14

The amount of buildup also increases with time and causes the boiler to consume more fuel to compensate for lost energy during heat transfer. Batey and McDonald, 2007 conducted a cost-benefit analysis of a potential transition from conventional fuel oil (2,000-2,500 ppm) to low sulfur fuel (0.05% sulfur by weight) in New York State. This earlier report estimates that boilers burning conventional fuel oil experience a decrease in efficiency of 2% per year due to fouling. This analysis assumes a zero-net change in fuel quantity, which is conservative given the availability of information. Estimates of household heating expenditures can easily be adjusted to account for different efficiency levels. A procedure for adjustments is presented in *Section 2.2*.

The rate of boiler fouling may also impact household expenditures on maintenance calls and routine boiler cleaning. Batey and McDonald, 2015 used a Boiler Fouling Scale to compare the relative rate of buildup for residential fuel oil compared to ULS fuels. After approximately one year of operation, the conventional fuel oil group scored 2.15 and the ULS group scored 0.47. The ratio of boiler fouling is then 2.15/0.47 = 4.6. This means that boiler fouling occurs in conventional fuel oil boilers at a rate that is 4.6 times greater than ULS boilers. As boilers are typically cleaned every 1.5 to 2 years, a boiler using ULS fuel would only need to be cleaned approximately every 6.9 years. The Batey and McDonald, 2007 analysis assumed an average boiler cleaning service call would require 1.1 hours of labor. They also assumed service call costs ranging from $44 - $104 per hour. Based on the reduction in maintenance from the fuel switch, they estimated average annual household savings of $16 - $40. These savings are presented in 2007 dollars for New York State residents. Potential maintenance savings to FNSB residents are most likely larger than the Batey and McDonald, 2007 estimates due to a higher cost of living. These maintenance considerations are not included in the cost scenarios.

Batey and McDonald, 2015 found that a switch from conventional fuel oil to ULS could pose some risk to boiler systems with certain types of lip seals present in some oil burner pumps. 85% of existing residential oil burning systems use black nitrile seals, which were unaffected by the change in sulfur content. However, a smaller proportion of brown 'Viton' type seals are highly susceptible to degradation from ULS fuels. These seals were used for a brief period in the early 2000's but were observed to have a much higher rate of failure than their nitrile substitutes. This may indicate a further increase in boiler repair costs for some households. With the proportion of the vulnerable seals so low, this effect is not included in the cost scenarios.

2.2 Heating Oil Cost Models

A cost model was developed using Fairbanks Home Heating Telephone Survey data from 2011-2015 collected by Sierra Research for DEC to estimate the impact on household fuel expenditures in the FNSB area. Scenarios were developed using five key assumptions, and are listed below:

Scenario 1: Annual household heating oil use of 1,230 gallons, an own-price elasticity of demand of -0.2, no net change in efficiency and energy loss, 5% rate of discount, and a price differential of 34 cents/gallon for ULS.

Scenario 2: Annual household heating oil use of 1,230 gallons, an own-price elasticity of demand of -0.2, no net change in efficiency and energy loss, a 5% rate of discount, and a price differential of 41 cents/gallon for ULS.

Scenario 3: Annual household heating use of 1,230 gallons, an own-price elasticity of demand of -0.2, no net change in efficiency and energy loss, 5% rate of discount, and a price differential of 7 cents/gallon between HS No. 1 and HS No. 2.

Table 9: Summary of Heating Oil Cost Model Scenarios

Scenario	Gallons of Prior Fuel Usage	Price Differential Cents/Gallon	Own-Price Elasticity
1. HS No. 1 to ULS	1230	34	-0.2
2. HS No. 2 to ULS	1230	41	-0.2
3. HS No. 2 to HS No. 1	1230	7	-0.2

Source: Alaska Department of Environmental Conservation, UAF Cost Model

2.2.1 Monte Carlo Simulation

One objective of this study is to utilize a Monte Carlo analysis as a tool to help predict the expected change in household heating expenditure given a range of ULS differential, annual household fuel consumption, and elasticity of demand estimates. The Monte Carlo analysis can also be used to verify the estimates from *Section 2.2.* In a Monte Carlo simulation, a random value is computed for each of the variables based on a range of the estimates provided. This makes the Monte Carlo a valuable tool for predicting the probability of a given outcome with either limited data or many variables. The Monte Carlo Analysis uses the minimum, maximum, and mean value of those distributions to generate five-thousand random trials based on the range of estimates to predict the outcome of each. Based on the results from the generation of values, the expected change in household heating expenditure is computed. For this analysis, the inputs: ULS differentials, HS No. 1 differential, annual household fuel consumption, and elasticity of demand estimates were varied using triangular distribution.

Table 10: Summary of ULS Monte Carlo Inputs

Inputs			
Variable	**Min**	**Max**	**Mean**
ULS Differential	0.2	0.4	0.34
Gallons of Fuel	45	5000	1230
Own-Price Elasticity of Demand	0.2	0.7	0.4
Current Fuel Price			
$2.10			

Source*:* Alaska Department of Environmental Conservation, UAF Monte Carlo Model

Table 11: Summary of HS No. 1 Monte Carlo Inputs

Inputs			
Variable	**Min**	**Max**	**Mean**
ULS Differential	0.05	0.10	0.07
Gallons of Fuel	45	5000	1230
Own-Price Elasticity of Demand	0.2	0.7	0.4
Current Fuel Price			
$2.10			

Source*:* Alaska Department of Environmental Conservation, UAF Monte Carlo Model

Table 11 and Table 12 present a summary of the inputs used to conduct the ULS Monte Carlo Simulation, and the HS No. 1 Monte Carlo Simulation. Both models used a constant fuel price per gallon of $2.10 to calculate the expected change in household heating expenditure below.[29]

2.2.2 Results of Monte Carlo Simulation

Table 12: Results of ULS Household Heating Expenditure

Annual Change in Household Heating Expenditures			
Min	**Max**	**Mean**	**Median**
$10.64	$1,185.35	$329.73	$294.86

Source*:* Alaska Department of Environmental Conservation Monte Carlo Model

Based on the results of the ULS Monte Carlo, the average change in annual household expenditure is approximately $329.73. The minimum change in expenditure is $10.64, and the maximum is $1,185.35. The results of the Monte Carlo further verify the estimates presented in *Section 2.2,* as the mean estimate of changes in household heating expenditures fall within the expected range of $311.96 and $374.86, with the median change in household heating estimates falling slightly outside the expected range.

Table 13: Results of HS No. 1 Household Heating Expenditures

Annual Change in Household Heating Expenditures			
Min	**Max**	**Mean**	**Median**
$3.00	$303.61	$84.32	$76.12

Source*:* Alaska Department of Environmental Conservation Monte Carlo Model

Based on the results of the HS No. 1 Monte Carlo, the average change in annual household expenditure is approximately $84.32. The minimum change in expenditure is $3.00, and the

[29] Alaska Energy Data Gateway, 2006

maximum is $303.61. The results from the HS No. 1 Monte Carlo Simulation is slightly outside the estimates calculated in *Section 2.2* at an average increase of $84.32 from a switch to HS No. 1, the median estimate was slightly closer to *Section 2.2* estimates at a predicted household expenditure increase of $76.12.

Table 13 and 14 present the estimated change in expenditure based on the Monte Carlo inputs. The change in expenditure based on the Monte Carlo simulations is calculated for both ULS and HS No. 1 as so:

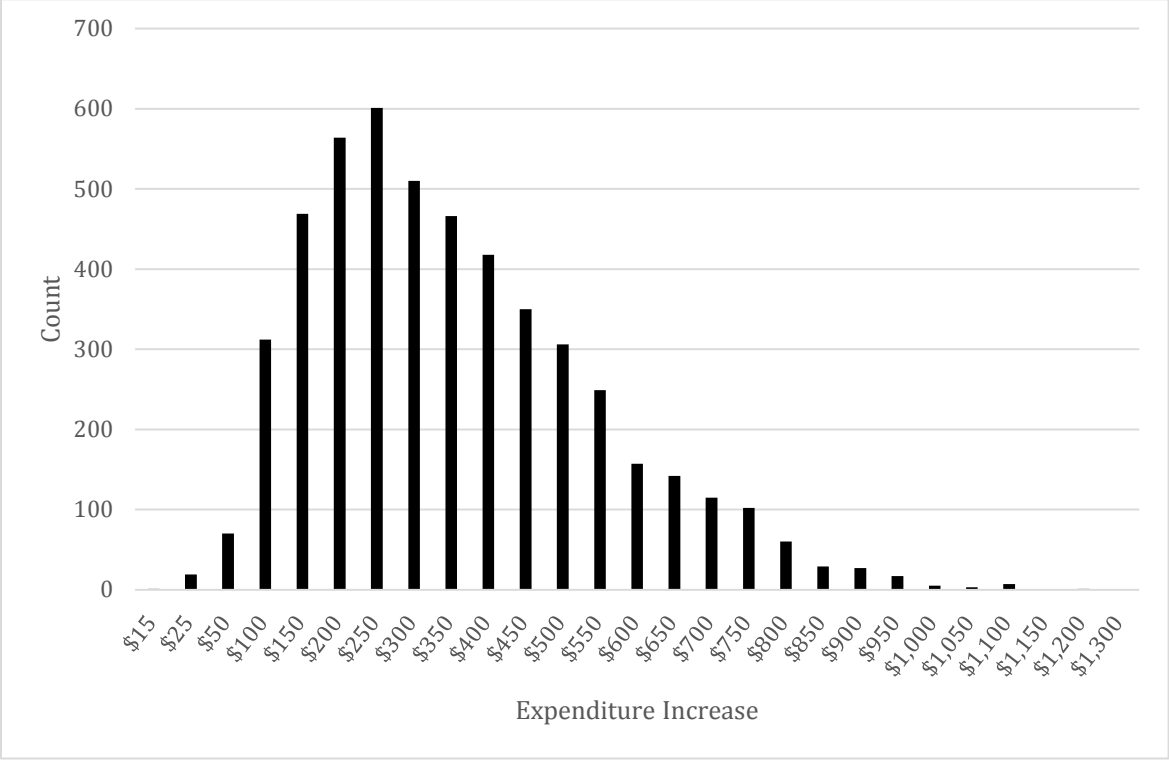
$$\left(\Delta Expenditure = \left(-Ed * \frac{Fuel}{Price}\right) * ULS\ Diff + Fuel\right) * (Price + ULS\ Diff) - (Fuel * Price)$$

Where *Fuel* is in gallons of heating oil per year used by the household, *Price* is the price of heating oil per gallon *ULS Diff* is the differential between HS No. 1 and ULS in the price per gallon. For example, using ULS Trial 1 calculations

$$\left(\Delta Expenditure = \left(-0.387 * \frac{603.19}{\$2.10}\right) * 0.28 + 603.19\right) * (\$2.10 + 0.28) - (603.19 * \$2.10) = \$96.16.$$

Using the above example, there is a predicted increase in annual household heating expenditure of $96.16.

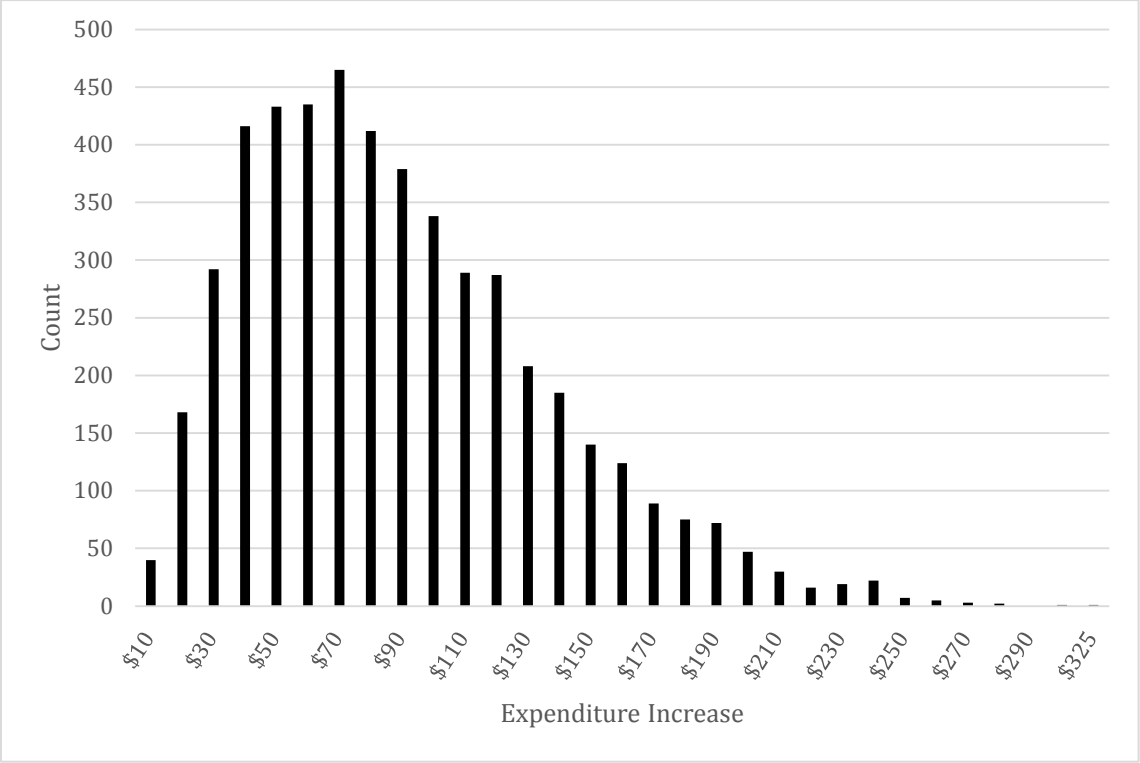
Figure 11*: *Distribution of Simulated Annual ULS Household Expenditure Increases



Source: Alaska Department of Environmental Conservation Monte Carlo Model

Figure 11 presents the triangular distribution of simulated expenditure increases based on the ULS differential. Based on the ULS price differentials: 20, 34, and 41 cents/gallon, the average change in annual household expenditure is approximately $329.73. The minimum change in expenditure is $10.64, with a maximum change of $1,185.35. The distribution of the data is skewed right, approximately 90% of households are predicted to incur additional expenditures of $650 or less in the first year given a switch to ULS.

Figure 12: Distribution of Simulated Annual HS No. 1 Household Expenditure Increases



Source: Alaska Department of Environmental Conservation Monte Carlo Model

Figure 12 presents the triangular distribution of simulated expenditure increases based on the HS No. 1 differential. Applying the HS No. 1 price differentials: 5, 7, and 10 cents/gallon, the average change in annual household expenditure is approximately $84.32. The minimum change in expenditure is $3.00 and the maximum is $303.61. Again, the distribution of the data is skewed right, 90% of households are predicted to incur additional expenditures of $160 or less in the first year given a switch to HS No. 1.

2.3 Summary of Household Impact

These estimates vary depending on the assumed household sensitivity to price changes and the price differential used. These estimates do not include the change in maintenance costs associated with changing to ULS, the potential switch to alternate fuels (for example wood or natural gas), or behavioral responses which reflect a change in home heating practices. It should be noted that these estimates do not account for the potential switch to wood consumption, as this is a concern for the FNSB area connected to the sensitivity of consumers to fuel price increases and the substitutability of the type fuel used in the home.

2.3.1 Household Impact from Switch to ULS

The estimated cost of a potential ULS transition to an average FNSB household would be between $311.96 and $374.86 in the first year, with models accounting for consumer sensitivity to prices and the lower price differential of 34 cents/gallon resulting in the lower estimates. This represents a percent increase in household heating expenditures of 13.5% - 16.5% in the first year given average annual household heating expenditures of $2,274. The ULS estimate is further verified by the results of the Monte Carlo simulation. Results estimate a mean increase in household heating expenditures of $329.73 or 14.5% increase in household heating expenditures which land within the immediate estimates. The discounted NPV of the increased cost from implementation to 25 years varies between $4,396.76 and $5,283.22, with the higher estimate being associated with the 41 cents/gallon price differential assumption and relatively inelastic demand.

2.3.2 Household Impact from Switch to HS No. 1

The estimated cost of a potential HS No. 1 transition (from HS No. 2) to an average FNSB household is $68.31 in the first year given a price differential estimate of 7 cents/gallon. The results from the HS No. 1 Monte Carlo Simulation is slightly outside the estimates calculated in *Section 2.2* at a calculated average increase of $84.32 or 3.7% in annual household heating costs.

2.4 Potential Benefits of Switch to ULS

Thus far, this analysis has provided estimates of the additional heating costs incurred by households from a potential switch from HS to ULS. The potential benefits associated with a switch to ULS discussed in this section are strictly qualitative. Benefits of a switch to ULS include reduced PM-2.5 emissions, which could result in potential health benefits for FNSB residents. Improved air quality from a reduction in sulfur oxide, particulate matter, and nitrous oxide, could reduce asthma and cardiovascular induced hospitalizations from PM-2.5 episodes during winter months (State of Alaska Department of Epidemiology, 2010). Environmental benefits include reducing ground level smog, which would increase visibility for drivers and pedestrians. Other benefits from a hypothetical switch could include increased heating equipment efficiency, and lower maintenance costs from reduced boiler fouling as discussed in *Section 2.1.5*.

2.5 Limitations

The data used in this analysis lacked some socio-demographic, housing characteristics, and price data. Data such as household income, number of individuals living in the household, and other household spending preferences was not collected from the initial household level surveys. Housing characteristics such as number of bedrooms/bathrooms, garage space, and household energy efficiency were not included in the data set.

There are current data limitations regarding the prices Fairbanks households pay for their firewood. If this analysis tried to incorporate firewood prices at this time data limitations would result in a lack of price variability in the modeled scenarios. Many households in Fairbanks report collecting their own firewood instead purchasing. It would be of great value to gather data on the length of time spent collecting wood.

Conclusion

A prospective switch to ultra-low sulfur (ULS) heating oil is predicted to increase residential heating expenditures for the typical Fairbanks North Star Borough (FNSB) household. This does not take into consideration any potential benefits of the change, such as savings in boiler maintenance, decreased costs associated with improved air quality, and other factors. The cost analysis provided in *Section II* (using the price differentials from *Section I*) represents the likely range of estimates for an increase in residential heating expenditures given the available information and scope of the analysis is between $311.96 and $374.86 in the first year. This represents a predicted increase in household expenditures of 13.5%-16.5% in the first year given annual household heating expenditures of $2,274.

A prospective switch to HS No. 1 from HS No. 2 heating oil is predicted to slightly increase residential heating expenditures for the typical FNSB household. The cost analysis provided in *Section II* of a hypothetical switch to HS No. 1 represents a predicted increase in household heating expenditures of $68.31 in the first year. This represents a predicted increase in household expenditures of 3% in the first year.

This analysis does not account for cross-price effects on alternative energy sources like firewood, even though many FNSB homes contain more than one heating appliance. Future research should examine household expenditures and determine whether the reduction in particulates and improvement in air quality are acceptable given the cost to consumers in the FNSB.

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Sierra Research Inc. Fairbanks Home Heating Telephone Survey Data 2006-2015 - Unified Format, provided July 2, 2018

Appendix A

This analysis estimates the typical FNSB household fuel oil usage to be 1,230 gallons per year. This assumption is based on the Fairbanks Home Heating Telephone Survey Data 2006-2015, collected and prepared by Sierra Research Inc. Analysis data on fuel usage was limited to the continuous time period from 2011-2015. The survey collected information on household characteristics, appliance types, and fuel consumption for home heating. The survey focused on heating oil, firewood, natural gas, and coal as the primary heating fuels, and asked respondents to estimate their fuel consumption in terms of annual quantity and expenditures. ADEC's estimate of household oil consumption isolated households that burned only oil in a central boiler. For households with a central oil burner and reported oil consumption > 0, the average FNSB home uses 1,230 gallons of conventional heating oil per year. All calculations were performed using the statistical analysis software, STATA.

Appendix B

Price elasticity of demand measures the responsiveness of the quantity demanded of a good to a change in its price. It is calculated by the percentage change in quantity demanded divided by the percentage change in price. Price elasticity of demand figures are presented in absolute terms, as they typically consist of negative values, due to the inverse relationship between price and the quantity demanded of a good or service.

$$E_d = \frac{\%\Delta Q}{\%\Delta P} \quad (3)$$

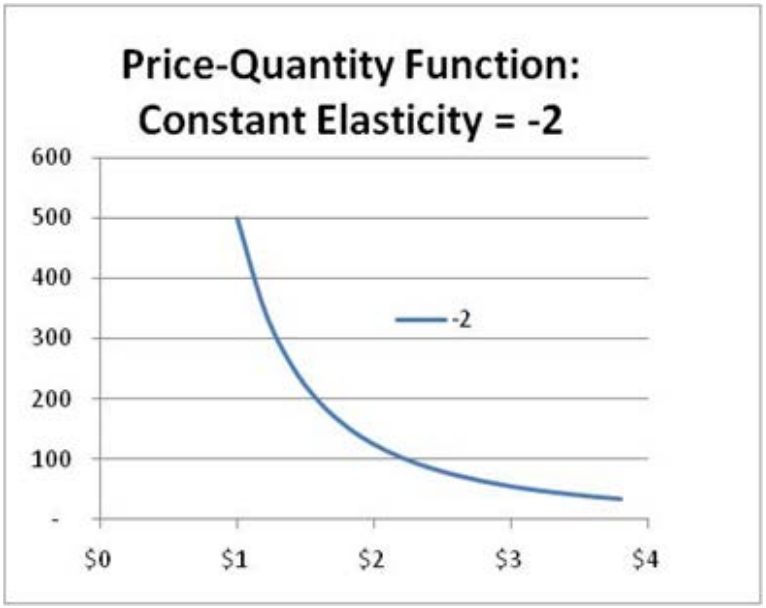
$$E_d = \frac{(Q_1 - Q)/Q}{(P_1 - p)/P} \quad (4)$$

These equations are all different ways to calculate the price elasticity of demand, with *equation 4* a more explicitly written version of *equation 3*. To find this value with calculus *equation 5* could be used. This uses the partial derivative of the quantity demanded with respect to the price of the good multiplied by the specific price of the good divided by the specific quantity demanded associated with that price.

$$E_d = \frac{\partial Q}{\partial P} \times \frac{P_0}{Q_0} \quad (5)$$

Appendix C

Figure 13: Price-Quantity Function Elasticity Example



Source: Farris & Pfeifer 2010

Constant elasticity demand function means the elasticity of demand is the same at every point along the demand curve, but the slope is different at every point. This is represented in *equation 6* where ε is the price elasticity of demand and k is a constant.

$$Q = kP^{\varepsilon} \qquad (6)$$

Instead of a linear demand function, a constant elasticity demand function is assumed for this analysis because of the numerous assumptions made about heating fuel demand in the Fairbanks area. The post-transition level of heating oil demand is not known, so we assume fixed elasticity demand values across a range of fuel quantities.

Appendix D

Monte Carlo Analysis

The Monte Carlo Analysis, or Monte Carlo Simulation is a method of analysis developed in the 1940's which uses statistical sampling to obtain a probabilistic approximation to the solution of a model or an equation. Monte Carlo analysis uses the process of approximating the output of a model through the repetitive and random application of the model's framework. Through this process, the Monte Carlo simulation tells us based on a range of estimates how probable the

resulting outcomes are. A Monte Carlo analysis can include a mix of point estimates and distributions for the input parameters.

Fairbanks North Star Borough

Transit Fleet Natural Gas Efforts

FINAL REPORT September 6, 2018

Compressed Natural Gas (CNG) Feasibility Study

Fairbanks North Star Borough

Project Location: 3175 Peger Road, Fairbanks, AK 99709

16-TRGPRJ-01 Transit Garage Expansion

Executive Summary

Wendel was hired by the Fairbanks North Star Borough (FNSB) as a sub-consultant to Design Alaska to assist in the programming and the design necessary for the expansion of the Borough transit garage and assess the costs and feasibility of the incorporation of compressed natural gas (CNG) as an alternate fuel for transit vehicles.

FNSB currently operates fifteen (15) heavy duty diesel transit buses for the MACS nine (9) fixed routes and a total of ten (10) gasoline powered buses for the Grey Line and Van Tran paratransit demand response ADA service. The study includes a recommended bus replacement plan and various twenty (20) year projected cash flow analysis based on the first CNG buses arriving in 2020 and fleet wide implementation of CNG by 2027.

Even with the higher cost of natural gas in Fairbanks, the projected fuel cost savings utilizing CNG versus diesel or gasoline is $1,438,959. Subtracting the $1,422,454 added cost for CNG vehicles results in a 20 year net operating cost savings of $16,504 for both fleets combined.

The report includes a recommendation that the Borough proceed with a Phase 1 CNG contingent design using the guidance provided in this report. Total estimated Phase 1 costs are $123,768 and facilitate the future buildout of a fully CNG compliant maintenance and storage facility.

The total estimated overall facility capital costs for the CNG program is $2,840,392 with the Borough owned CNG fueling station being the largest estimated expense at $2,175,722. Although the fuel cost savings are not enough to also cover the added cost of CNG facility upgrades and CNG station costs, the Borough should consider the overall benefits of a future fleet wide implementation of CNG bus operations.

The CNG fueling station compressor and fueling system design recommended in the report meet the anticipated CNG usage required for conversion of the entire current fleet. The station can also handle an additional 10% expansion of the MACS and Van Tran transit fleets.

The net benefit of replacing both vehicle fleets with CNG vehicles produce significant reductions for each of the criteria pollutants (i.e., PM2.5, VOC, CO and NOx) as well as significant reductions in the carbon dioxide (CO_2) greenhouse gas emissions.

Fast Facts - During the 20 year period of the study:

- The amount of liquid fuels estimated to be displaced by CNG fuel is:
  - 2,109,555 diesel gallons for the 15 buses for the MACS fleet
  - 476,749 gasoline gallons for the 10 buses for the Van Tran fleet

- The estimated fuel cost savings of operating CNG buses is estimated to be:
  - $872,248 savings for the 15 buses for the MACS fleet
  - $566,711 for the 10 buses for the Van Tran fleet

- The initial increased cost of purchasing CNG buses is estimated to be:
  - $891,311 for the 25 buses for the MACS fleet
  - $531,143 for the 27 buses for the Van Tran fleet

Introduction

Fairbanks North Star Borough (FNSB) has commenced the programming and the design processes necessary for the expansion of the Borough Transit Garage. To aid in the planning process, this compressed natural gas (CNG) feasibility study will evaluate the potential cost, operational, and environmental impacts as a result of the incorporation of compressed natural gas (CNG) as an alternate fuel for transit vehicles. Included will be an overview of the financial impacts of constructing the new facility to accommodate the storage and maintenance of CNG vehicles and the costs of a privately owned CNG fueling facility on the property.

The initial evaluation was conducted May 1-3, 2018 in Fairbanks and included visits to the site at 3175 Peger Road. This process was conducted by the consulting team of Wendel, Design Alaska, and RIM Architects and included scheduled meetings with a number of Borough bus operations staff members and included a meeting with the natural gas provider Fairbanks Natural Gas, LLC.

The consulting team also met at the City of Fairbanks offices with Building Plans Examiner Stephen Anderson, Electrical Inspector Clemens Clooten, and Assistant Fire Marshal Kyle Green. Site plan ideas, and overall approach to facility requirements and potential CNG fueling station project and various code compliance issues were presented. This was an excellent meeting with very good discussion and engagement of City officials and fire marshal office.

The site assessment reviewed site layout, existing electric and natural gas utilities servicing the site, current site and building conditions. The operations assessment reviewed current fueling patterns, frequency of fueling occurrences, quantity of fuel required, and the amount of time required to perform fueling and service functions. Assessment includes both vehicles currently in the fleet, and those that may be added in the future as directed by FNSB.

The report identifies the necessary construction considerations for the new storage and maintenance facility to be in compliance with codes to allow for CNG vehicle storage including major repair work on CNG vehicles, engines, and onboard fuel storage systems.

The report confirms pressure and flow rate information for the proposed natural gas service, and provides an estimated annual usage of natural gas through a 10-year bus and paratransit replacement plan.

The report makes recommendations for a CNG fueling station as to the type of fueling system, site layout, location of dispensers, size of compressors and storage, etc. The report includes cost estimates for all recommended improvements

FNSB is exploring the utilization of Compressed Natural Gas (CNG) vehicles for city bus operations. This report examines a variety of issues involved in transitioning the heavy duty transit and paratransit vehicle fleets from diesel and gasoline to CNG. The study explores the capital and operational financial impacts of purchasing new replacement CNG buses. The primary vehicle financial impacts are with the added cost of the CNG engines, fuel systems, and storage tanks. Information on the safety of natural gas buses, changes in maintenance practices and suggested CNG training requirements are included in the report.

Some of the initial up front capital investments in CNG can be sizable, but in most cases can be considered a one-time expense. If you're building a costly fueling station such as that for CNG, this cost can be amortized or depreciated into the price of the fuel. This report provides the opinions of probable cost of a potential fueling station and projected fuel costs. Requirements and high level cost estimates for recommended measures to meet CNG code compliance for fleet storage, maintenance, and service areas are provided for the new operations and maintenance facility.

It is important to bear in mind when reading this report that the net present value of estimated annual cash flows and investment internal rates of return figures used are net differences in operating diesel and gasoline vehicles compared to CNG vehicles. Included are the extra incremental capital investments in new CNG vehicles, CNG facility requirements, and a new CNG fueling station on site. Natural gas costs for Alaska and Fairbanks are unique and much higher compared to the lower 48 states and this analysis highlights that reality. The environmental benefits are examined to quantify the emission reductions for separate pollutants (i.e., $PM_{2.5}$, VOC, CO, NOx, and CO_2) as a result of operating a CNG bus fleet versus the current diesel and gasoline buses.

Background

A number of issues need to be addressed when transitioning a fleet from traditional fuels to compressed natural gas. The following areas were addressed in the study:

A. CNG Vehicle Capital Costs
B. CNG Requirements For Maintenance, Fueling, and Bus Storage
C. Site, Fleet, and Fueling Analysis
D. CNG Fueling Station
E. Projected Diesel, Gasoline and Natural Gas Costs
F. CNG Diesel/Gasoline Gallon Equivalent (DGE/GGE) Cost
G. Safety, Training, and Maintenance Requirements for CNG Vehicles
H. Environmental Benefits of CNG Vehicles
I. Financial Analysis and Feasibility of the Overall CNG Project

A. Vehicle Capital Costs

1. CNG Vehicles

In the event a decision is made to transition fleets to CNG, it is recommended that the entire MACS and Van Tran fleets be replaced with CNG buses as soon as possible in order to achieve the maximum use of the CNG infrastructure investment. Wendel created a recommended 20 year fleet replacement schedule (Appendix A-1) for 1) the current MACS fixed route transit fleet replacements, and 2) the current Van Tran fleet replacements. The resulting schedule was used for the purposes of estimating fuel consumption and projecting the resulting financial impacts. Conversion of existing vehicles is not financially feasible and not recommended.

2. Borough Vehicle Equipment Fleet Fund (VEFF)

Wendel recommends setting up a formalized procurement cycle for buses and advises that the Borough at a minimum annually budget into the VEFF the typical 20% local match required to leverage state and federal grant programs. The fleet plan staggers replacements creating a more manageable system of bus replacements in the future. Once the fleets are replaced with CNG vehicles the recommended fleet replacement plan places MACS fixed route buses on a 15 year lifecycle and Van Tran paratransit cutaways on a 7

years lifecycle. The manufacturers recommended and Federal Transit Administration (FTA) required minimum service life policy is 12 year for heavy duty large bus and 5 years for light duty mid-sized buses. The FTA criteria has been in place since 1985. It is a generally accepted principal that extending vehicles significantly beyond the designed lifecycle leads to costlier repairs to systems on the vehicles that are generally not recouped during the remaining time the vehicle continues to be operated.

3. Fleet Replacements

The FNSB transit fixed route fleet is comprised of 15 fixed route buses. The fleet consists primarily of 30 and 35 foot diesel buses and also includes 2 – 2013 40 foot diesel buses expected to be transferred to FNSB from Anchorage, AK. The recommended fleet replacement schedule replaces all MACS buses by 2027 within the first 9 years of the feasibility plan scenario. The Borough is already planning 4 replacements of 2007 Gilligs in 2020 and 3 additional are recommended each year in 2021 and 2022. This completes the replacement of the 10 older 2007 Gilligs. The remaining 3 – 2014 Gilligs are replaced in 2026 and the final 2 – 2013 40 foot Gilligs from Anchorage are replaced in 2027 to complete the conversion to CNG for MACS.

The Van Tran fleet has a total of ten (10) E-350 and E-450 Ford cutaway (a bus body purpose built on an existing chassis produced by manufactures such as Ford, Chevrolet, International, etc.) gasoline powered buses for the Grey Line and Van Tran paratransit demand response ADA service. The Borough already has 3 buses scheduled for replacement in 2019. Because the natural gas fueling infrastructure would not likely be in place until 2020 it is recommended those 3 units be replaced with gasoline vehicles. The Borough could then begin purchasing CNG cutaway vehicles with 2 each in 2020 and 2021, 1 each in 2022, 2024 and 2025, and the remaining 3 in 2026 to complete the conversion to CNG for the entire Van Tran fleet.

Table I. on page 3.3 lists the years and number of replacements for each fleet. The green highlight indicates when full CNG fleet implementation has been reached.

Table I. - CNG Fleet Replacements MACS & Van Tran

Fiscal Year	MACS Fleet	Van Tran Fleet
2019	0	3 – Gasoline
2020	4	2
2021	3	2
2022	3	1
2023	0	0
2024	0	1
2025	0	1
2026*	3	**3**
2027*	**2**	2
2028	0	2
2029	0	1
2030	0	0
2031	0	1
2032	4	1
2033	3	3
2034	3	2
2035	0	2
2036	0	1
2037	0	0
2038	3	1
*** Entire Fleet Operating on CNG**		

In the current market there are only two available CNG engine for heavy duty large transit buses. Those are the Cummins-Westport ISL-G and ISL-G-NZ (Near Zero) engines. The ISL-G is the standard CNG engine and the NZ model is an optional low NOx (oxides of nitrogen) natural gas engine with exhaust emissions that are 90% lower than the current EPA NOx limit of 0.2 g/bhp-hr (grams per brake horsepower-hour). The ISL G is a spark ignited, factory-built dedicated natural gas engine, manufactured by Cummins on the same assembly line as the ISL-9 diesel used in many of FNSB's current MACS transit buses. Cummins-Westport was formed in 2001 as a 50:50 joint venture between Cummins Inc. and Westport Innovations.

The price differential for a new Gillig CNG bus with a 155 diesel gallon equivalent (DGE) CNG tank system and a Cummins ISL-G natural gas engine is estimated to be $48,397. This configuration is dedicated CNG operation. Cost figures were verified through a comparison of Washington State bid sources where a 35 foot Gillig bus base bid is priced at: $419,616 for diesel and $477,040 for CNG with the ISL-G-NZ (Near Zero). A New Flyer bus is priced at $439,070 for diesel and $468,013 for ISL-G CNG. The differential utilized for the financial analysis compares the lower cost Gillig diesel with the lower cost New Flyer CNG. This price differential could be $6,000 lower in the event the Gillig CNG Bus is chosen without the more expensive ISL-G-NZ low NOx natural gas engine which carries a $15,000 premium on the Gillig CNG pricing for the Washington state bid.

The price differential for a new Ford E350 and E450 StarTrans cutaway with a dedicated CNG package versus a gasoline engine is $22,000. Pricing was provided by Ford authorized CNG installer A-1 Alternative Fuel Systems in Elkhart, Indiana. A-1 is a Ford Qualified Vehicle Modifier (QVM). It is important to work with only QVM suppliers to ensure that the Ford OEM warranty will remain intact on any vehicle modified.

The E-350 6.2L w/ Gaseous Fuel Prep Engine Package - 20 GGE $20,500 - $21,000; 30 GGE $21,500-$22,000. The E-450 6.8L w/ Gaseous Fuel Prep Engine Package - 30 GGE $17,500-18,000; 40 GGE $19,500 - $20,500. Because the E350 6.2L is the most common in the fleet the higher threshold cost of $22,000 was used for the study. CNG storage tanks are generally installed under the bus body on the chassis, but other roof and rear compartment options are also becoming available. Cutaway CNG buses would be ordered as a dedicated CNG configuration and not a bi-fuel application. In bi-fuel applications the vehicle can start on gasoline and then switch to CNG operation.

The financial scenario period of the study extends to 2039. The recommended fleet replacement plan illustrates the actual lifecycle after replacement to CNG with all future CNG replacements assuming a bus lifecycle of 15 years for large bus and 7 years for cutaways. After the fleet is 100% converted to CNG, additional vehicle upcharges are also proportionally cost allocated through 2039 for assumed future replacements of the CNG buses listed in Table I. CNG Fleet Replacements MACS & Van Tran on page 3.3.

B. CNG Requirements for Maintenance, Fueling and Bus Storage

Looking down the center isle of a typical transit maintenance garage with opposite facing maintenance bays.

Evaluating the impacts to buildings where CNG vehicles may be maintained and stored is an important element of the study. CNG is natural gas (methane CH_4) compressed for on board vehicle storage and used as a fuel source. Methane is lighter than air, naturally rises, and is part of nearly everyone's daily life as the natural gas we use to cook and heat our homes. In its naturally occurring state, it is odorless, colorless, tasteless and nontoxic. Methane is highly reactive with oxygen, making it a valuable fuel but also an explosive danger if not properly detected and controlled. At certain levels natural gas is highly explosive so methane sensors are used to detect and automatically ventilate spaces well before natural gas reaches dangerous levels.

This section of the report provides our code review analysis, design options and high level opinion of cost for the building construction and systems required and recommended for CNG vehicles. At the time of this report it should be noted that in preparing this analysis, the local jurisdiction has adopted International Mechanical Code (IMC) 2015 for ventilation. Chapter 4 Table 403.3.1.1 of the IMC contains the current requirements. In the event a newer codes is adopted the CNG requirements for maintenance, indoor fueling and bus storage should be re-examined for possible changes.

1. Maintenance Repair Areas

The appropriate codes look at maintenance repair bays in two different categories; major repair and minor repair. Major repair consists of repair on the fuel systems as well as body work, welding, grinding, etc. Minor repairs include activities such as brake changes, tire

changes, oil and lube services. For the cost estimate, two scenarios are presented, 1) determining the cost of making the entire maintenance area compliant for major maintenance, 2) partition off two repair bays and pricing the partition and mechanical system. When ultimately determining the pros and cons of the chosen approach FNSB can also understand the financial impacts.

The major repair area has minimum ventilation requirements in cubic feet per minute (CFM) to ensure that any released gas can be safely evacuated from the building. Ventilation is required at a rate of 1 cfm/12 cubic feet (CF) of room volume, which is equivalent to five air changes per hour. This can be handled by continuous ventilation, or by having a gas detection system interlocked with emergency exhaust fans that can provide this ventilation rate. With Fairbank's outside air temperatures and quality, the continuous ventilation approach is not desirable. The minor repair areas do not have any code specific requirements beyond the minimum ventilation rate required for a diesel maintenance garage. The minimum ventilation rate currently required by code is 0.75 cfm/sf.

It is common practice to provide a gas detection system throughout a repair garage that monitors for carbon monoxide (CO) and nitrogen dioxide (NO_2). Having this system in place as a base design would allow detectors to be added to monitor for methane as well. With a nominal expansion to the base gas detection system it would be fairly simple to meet the intent of the code for CNG. This system would be interlocked with emergency exhaust fans that upon detection would energize and purge the space. In this case, only the minimum ventilation rate of 0.75 cfm/sf would be required continuously, and not five air changes.

Because continuous ventilation would not be provided, and because methane is lighter than air naturally rising to the highest point of the facility, the top 18 inches of the space near the ceiling would have to be classified as Class 1, Division 2 (explosion proof) as defined by the National Electric Code (NEC). To mitigate additional electrical work if CNG is adopted in the future all electrical raceways or wiring should be designed and constructed outside of this classified zone. Any wiring that is installed or would be passing through this zone would have to comply with requirements for installation within Class 1, Division 2 zone. The lighting fixtures provided in the repair bays have to be vented or designed (typically lensed)

in such a way as to prevent collecting any gas inside the fixture.

In major repair areas, heat producing equipment shall not consist of open flame heaters or any equipment with exposed surface temperatures in excess of 750°F.

The previous design and construction considerations can easily be applied to the entire repair garage area, allowing the greatest user flexibility. Any bus can be pulled into any bay to do any type of work.

Often times in an effort to reduce overall construction cost, especially in existing buildings, major maintenance of CNG vehicles can be restricted to a limited number of maintenance repair bays. By providing a rated separation from the rest of the facility, only a dedicated area of major maintenance would have to be up-fitted with methane detection and emergency exhaust fans. For repair bays to be isolated, interior walls must separate the maintenance bay from the rest of the building and are to be continuous from floor to ceiling, securely anchored, and maintain a 2 hour fire rating. Each maintenance repair bay would also require a vapor-sealing, self-closing 2 hour rated overhead door. In our analysis with new construction it is actually less costly to have the entire maintenance area CNG compliant as compared to constructing two CNG complaint work repair bays.

Finally, a typical diesel vehicle repair garage will be equipped with hose reels for tailpipe exhaust systems. This system is necessary to safely remove the exhaust of any vehicle that needs to be running indoors to perform maintenance or testing. A standard diesel bus requires a system that can handle temperatures of 700°F with an exhaust airflow of 700 CFM. CNG buses have discharge temperatures near 1170°F and airflow rates of approximately 1180 CFM. Our cost estimate captures the difference in cost between these two options to better understand the upgrade cost to CNG. Whether the garage is designed for immediate use of CNG vehicles or designed with the thought that CNG vehicles may procured in the future, it would be beneficial to install the system with the fans and hoses that can handle the higher temperatures and flow rates.

2. Indoor Fueling and Service Lane Area

Fueling CNG buses indoors provides shelter from the weather, as well as a controlled work environment. It is important to understand the National Fire Protection Association (NFPA), CNG code restrictions and implications that come with indoor fueling. Per earlier versions of the NFPA 52 (Vehicular Natural Gas Fuel Systems Code), when there is a room within a building where CNG is dispensed, the International Fire Code (IFC) required deflagration venting to be provided in exterior walls and/or roofs. Deflagration venting is a means of controlling damage by releasing explosive forces through a wall or ceiling panel opening engineered for that purpose. At least one wall must be an exterior wall and any interior walls separating the fueling room from the rest of the building are to be continuous from floor to ceiling, securely anchored, and maintain a 2 hour fire rating. By providing the deflagration panels and securing the interior walls, if there was ever a pressure releasing event, the area is designed to release outward and away from the rest of the building. Access to the room from within the building is permitted where it is through a barrier space having two vapor-sealing, self-closing fire doors. Essentially this is a vestibule type design. This requirement has changed however within the NFPA 52 - 2016 update and does not require deflagration panels. This will need further discussion with the stakeholder group.

For indoor, fast-fueling, with outdoor storage and compression, attended fueling requires a gas detection system equipped to sound a latched alarm and visually indicated when a maximum of one-fifth of the lower flammability limit is reached. Actuation of the gas detection system shall shut down the compressor and stop the flow of gas into the structure. Reactivation of the fueling system must be by a manual reset. Again, CO and NO_2 detection would be provided as a base design so methane detection would need to be provided in the fueling area and tied into the gas detection system as a separate zone. This will be interlocked with emergency exhaust fans located in this space. The emergency exhaust fans would be required to be mounted on the highest point of the roof and exhaust the air from within the top 18 inches of the service lane area of the building. Fans would be sized to exhaust at a rate of five air changes per hour. Make-up air would have to be provided and supplied low in the space to facilitate uniform air movement across the room. Providing the air low, would help reduce the potential of freezing pipes, but care must be taken in the design so if the system were to activate, additional damage was not caused by freezing and

bursting water piping.

CNG fueling inside of the building requires classification of the entire space designated as fueling to be classified as Class 1, Division 2 per the NFPA 70. The National Electrical Code (NEC), or NFPA 70, is a regionally adoptable standard for the safe installation of electrical wiring and equipment in the United States. It is part of the National Fire Codes series published by the NFPA. All electrical equipment such as panelboards, lighting and similar devices that are provided within the space have to be listed for use in such areas. All of the associated wiring methods also have to comply with requirements as described in the NEC for installation within Class 1, Division 2 areas.

In fuel dispensing areas, heat producing equipment shall not consist of open flame heaters or any equipment with exposed surface temperatures in excess of 750°F. All forced air heating, air-conditioning and ventilating systems serving this area are required to be dedicated systems and not serve any other part of the building. The fuel dispensing area shall be located at street level with no dispenser located more than 50ft from the vehicle exit to, or entrance from, the outside of the building.

3. Bus Storage Area

Although the buses being stored indoors are fueled by CNG, there is very little impact of CNG on the space requirements for this area. Since the buses are essentially sitting idle and not being worked on, there is very little potential for a leak and/or release. The code addresses this typically as an area that does not require any additional systems for CNG. In the base facility design this space would require only the minimum amount of ventilation as required by code which is 0.75 cfm/sf. This minimum ventilation requirement satisfies the presence of CNG. It should be noted that the code does allow an exception to provide a reduced airflow as low as 0.05 cfm/sf if a gas detection system is installed and interlocked with emergency exhaust fans. The gas detection system would need to monitor CO and NO_2. This would be a decision of the design engineer providing the base system, but would be beneficial to save on energy costs and reduce the amount of outside air being brought into the space.

Even though no additional equipment is required by code for CNG vehicles in this space, some owners want the peace of mind to know that they are adequately informed if there is a leak. Methane detectors could be added onto the base systems gas detection equipment and provide alarms if certain levels of methane were reached. This would be above and beyond the code, but might be seen as value added with a small premium in overall price.

CNG Ready Facility Premiums *

Option A: $374,550 - Entire Repair Facility CNG Complaint

Option B: $396,125 - Two Separated CNG Compliant Repair Bays

Indoor CNG Fueling: $97,996

Bus Storage: $99,109 – *Optional* Methane Detection Add-On

* Cost for equipment, escalation costs for Alaska construction, contingency, general conditions, or the general contractor fees as outlined in the attached Appendix Exhibit A-4.

C. Site, Fleet and Fueling Analysis

1. Current Site Layout

The FNSB transit operation is located at 3175 Peger Road and is comprised of Administration, Operations and Maintenance Offices and Parking, Bus Maintenance Repair, Bus Parts, and Indoor Bus Storage, Internal Fueling and Service Lane (A). The balance of the site is parking, storage, green space or unimproved areas. The Borough Emergency Operations building is to the west of and connected to the Transit Garage facility (B).

3175 Peger Road - Aerial Map View

The current bus flow on the property is not defined by signage but typically movements are in and of the lot from the main Northwest entrance (top left of photo). The opposite Southwest entrance/exit also can accommodate fixed route or paratransit bus traffic.

2. Current Utilities

a. Electrical Service

The site is currently serviced by Golden Valley Electrical Association. There are distribution lines and ample three phase overhead lines near the site to serve a new CNG station. The exact voltage needs to be field verified in design by the electric utility. The large size of the electric motors required on a CNG station will require a separate electric service and meter. It is anticipated that there would be a $9,381 approximate cost for providing the new meter and services. Once a location is chosen, typically a minimum of two weeks is required for planning and four-six additional weeks for engineering before improvements could be ordered for construction. It is anticipated that this would have no significant construction timeline on a potential CNG station.

b. Natural Gas Service

The site is currently serviced by Fairbanks Natural Gas (FNG) LLC. Wendel met with President and CEO Daniel Britton at the FNG offices on May 3rd. There is currently a very good natural gas service line to the site and current building. The current system volume and 60 psi pressure are more than adequate for the demand that will be required for a CNG station that would adequately serve both the MACS and Van Tran vehicles. The available volume could significantly increase the number CNG vehicles fueled per hour.

The CNG station will require a dedicated higher pressure gas line gas meter. FNG charges $50.00 for the first 100' including meter and $7 for each additional foot. The distance is approximately 800 feet for an estimated cost of $5,000.

3. Frequency of Fueling Occurrences

FNSB provided daily, monthly and yearly fueling data for both MACS and Van Tran vehicles. Although some minor fueling could occur throughout the day, the majority of fueling and servicing operations are handled by one or two service staff beginning at 6:00 pm and ending between 2:30 – 3:00 AM Monday – Friday. There is limited fueling on Saturday. The frequency of fueling remains fairly constant at two (2) vehicles per hour in one service lane. The time requirement is currently about 20-30 minutes per vehicle. Interviews with staff highlighted that additional cleaning operations and vehicle checklist service items are performed in the service lane requiring extra time.

4. Quantity of Fuel Required

Sample diesel refueling data was analyzed to provide an accurate representation of current maximum fueling requirements. Tables II. MACS Diesel Fuel Consumption summarize the gross daily fuel gallons based on this sample fueling data for the current fleet. Currently Van Tran vehicles fuel at a local gas station so no timed refueling data was available.

Table II. – MACS Diesel Fuel Consumption

Unit Num	Annual Gallons	Monthly Average	Daily Average
141	9,893	824	39
142	9,617	801	38
143	9,928	827	40
71	11,071	923	44
710	7,598	633	30
72	8,014	668	41
73	7,566	630	42
74	6,481	540	42
75	7,139	595	33
76	8,187	682	33
77	7,213	601	30
78	5,466	456	30
79	7,717	643	31
T945	80	7	13
T946	1,305	109	21
Averages	8,145	679	36
Totals	107,275	8,939	540

* Excludes Units T945-T946

The critical measure for design of the CNG compressors and dispensers is the maximum required natural gas volume per hour necessary to meet the number of equivalents gallons of gasoline or diesel fuel needed each hour of fueling. One DGE is equivalent to 143.94 cubic feet and one GGE 126.67 cubic feet of natural gas.

The Monday – Friday maximum daily (540 diesel gallons) requirement for natural gas is 77,728 cubic feet per day or approximately 388,638 cubic feet of natural gas per week for the large bus fleet. The current hourly fueling throughput requirements for the current fleet is only two buses per hour or the equivalent of 60-85 diesel gallons. This translates to a requirement for maximum natural gas volume of only 12,235 cubic feet per hour. Adding Van Tran fueling increases this but would have minimal hourly impact to evening fueling.

The CNG station compression is sized for the evening timeframes Monday-Friday when maximum throughput of fueling operations are realized. However the current gas service

could provide the capability to pull a much larger volume of cubic feet of gas per hour with larger compressors.

The baseline projected DGE average per year for each fixed route bus is 8,145 gallons. The baseline projected GGE per year for each paratransit buses is 2,821 gallons. The Van Tran fueling averages are based on fiscal year 2016 and 2017 mileage and fuel consumption data.

Utilizing the projected but as yet un-adopted fleet replacement schedule, the fuel consumption and resulting demand for natural gas has been estimated. Table III. Projected Vehicle Natural Gas Usage – Fully Implemented provides a summary of the volume of anticipated natural gas demand during initial fleet replacements to CNG through full implementation to CNG as of 2027. This information can be shared with FNG in the event a CNG project moves forward. An MCF is equal to 1,000 cubic feet of natural gas.

Table III. – Projected Vehicle Natural Gas Usage – Fully Implemented

Fiscal Year	Fixed Route CNG Buses	Paratransit CNG	Monthly MCF	Annual MCF
2020	4	2	450	5,404
2021	3	2	803	9,636
2022	3	1	1,126	13,511
2023	0	0	1,126	13,511
2024	0	1	1,156	13,868
2025	0	1	1,185	14,225
2026	3	3	1,568	18,814
2027*	2	0	1,763	21,159
*** Entire Fleet Operating on CNG**				

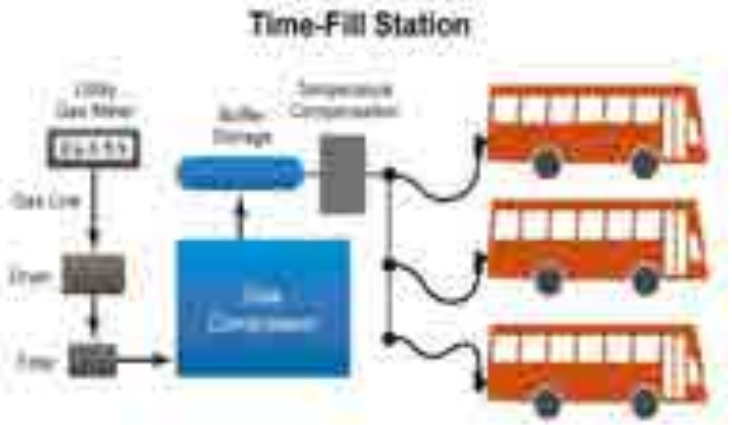
D. CNG Fueling Station

The biggest challenge to natural gas use for transportation overall is fleets cannot convert their vehicles without a place to fuel, and fueling stations require significant upfront capital

investments. In order for natural gas vehicles to be feasible for transit operations, fuel must be readily available and convenient.

1. Fueling Station Type

An analysis of fueling requirements was conducted for full implementation of the current fleet replacement for MACS and Van Tran identified in Table I. and referenced in Appendix A-1. There are typically two types of CNG stations, time-fill and fast-fill (see diagrams right). The main structural differences between the two systems are the amount of storage capacity available and the size of the compressor(s). These factors determine the amount of fuel dispensed and time it takes for CNG to be delivered. Drivers filling up at a fast-fill station experience similar fill times to a conventional fueling station. Because of the equipment requirements for more rapid fueling, fast-fill is also a more expensive option to implement. The option of a time-fill CNG station was examined and also found to not be feasible. This is primarily due to the daily fueling requirements and operational logistics including future probing, cleaning, fluid checks and other necessary end of day service requirements occurring at the service lane. Based on the transit operating characteristics and constraints at FNSB, we are suggesting a cascade type fast fill station. The system will be capable of dispensing 84 DGE or 96 GGE from storage without running the compressor(s).



2. Fueling Station Requirements & Location

The station requirements for this study are based on the recommended fleet replacement schedules referenced in Appendix A-1. This includes fueling 15 fixed route and 10 paratransit vehicles at full CNG implementation.

The compressors proposed are sized to handle this as well as the anticipated 10% planned growth and meet the current DGE fueling rates. A typical standard compressor package is rated at 72 decibels at 10 feet. An individual outside the fenced enclosure would typically be more than 10 feet away. Normal conversation can be heard at 3-5 feet when 70 decibels of environmental noise is present. Based on this criteria, and the proposed station location, the noise associated with compressor operations should not be detrimental to adjoining properties. Because the station is sized for evening operations there would be ample time throughout the daytime hours to fuel other Borough vehicles as well. Please note SCF refers to standard cubic feet, SCFM refers to standard cubic feet per minute, and GPM refers to gallons per minute. The station consists of two 230 SCFM compressors each paired with 100 HP electric motors. Table IV. Maximum Hourly Natural Gas Requirements illustrates typical fueling rate comparisons for CNG versus diesel and gasoline liquid fuels, including the comparison for the 230 SCFM sized for the FNSB design.

Table IV. - Maximum Hourly Natural Gas Requirements

Equivalent	SCF	Equivalent	SCF
Diesel Gallon	**143.94**	**Gasoline Gallon**	**126.67**
Requirement	**SCFM**	**Requirement**	**SCFM**
# 1.6 GPM	230	# 1.8 GPM	230
# 3.2 GPM	460	# 3.6 GPM	460
5 GPM	720	5 GPM	635
6 GPM	863	6 GPM	762
7 GPM	1,008	7 GPM	889
8 GPM	1,152	8 GPM	1,016
Maximum Hourly	SCF	Maximum Hourly	SCF
Output @ 5 GPM	43,200	Output @ 5 GPM	38,100
Output @ 6 GPM	51,780	Output @ 6 GPM	45,720

#Note: The FNSB system is designed to operate one 230 SCFM compressor at a time with the second compressor as a redundant unit. As illustrated in Table IV Maximum Hourly

Natural Gas Requirements, without using any of the designed storage capacity, at 1.6 DGE per minute 48 DGE can be delivered in 30 minutes or 96 DGE per hour. As stated earlier in the report the current hourly fueling demand ranges from 60-85 DGE fueling 2 buses per hour. Compressors are programed to operate alternatively but could also be set up to run concurrently during high demand to provide double this volume.

3. CNG Compressor Compound

As part of the overall project design a compressor compound location has been chosen that would sit outside the new operations and maintenance building service lane. This location offers the least impact to parking, bus flow and operations on the site and allows for an outdoor fueling dispenser as a backup. The CNG compound will be located outside, adjacent to the building, but a minimum distance of 10ft must be maintained to satisfy NFPA 52 (Vehicular Natural Gas Fuel Systems Code) clearance requirements. The preliminary compound approximately 53 feet long and 25 feet wide. The layout is illustrated in Appendix Exhibit A-4.

The main mechanical equipment within the station compound would consist of a manually regenerated single vessel natural gas dryer, two (2) 230 SCFM 100HP natural gas compressors, a bank of three (3) stacked 23' ASME CNG storage vessels, priority panel, electrical switchgear, and other necessary equipment. The entire compound would be protected by bollards. A provision is included for an emergency backup generator. This suggested layout is preliminary in nature and would be subject to final design requirements and approvals.

Based on the rate and volumes of fueling over the evening shift a cascade type fast-fill system is recommended. The three (3) storage vessels are utilized to provide the best fill possible on a vehicle. Natural gas is unlike a liquid fuel where you pump it in until the tank is full. When gas transfers between tanks the pressure equalizes over that volume. A cascade fill system is separated into 3 different types of storage tanks. Although all the tanks are physically the same, they are labeled the high-bank, mid-bank and low-bank. Each tank is piped separately through a priority panel. This panel contains the logic to use the

storage systematically to maximize the usable volume as well as provide each vehicle with a full fill. Using this approach multiple vehicles can be filled before the compressor is required to start up. Typically the logic within the system will have a set point on the low-bank and start up the compressor when the volume of the low bank reaches a preset amount.

The cascade system for this application allows fueling to occur from storage until such time that the compressor is needed. The compressor is able to be sized smaller because of the known fueling duration. The compressor will run to refill storage and keep running as vehicles continue to fill and draw off of storage. At a minimum, the compressor will run for nearly an hour just to fill the storage from the first few fills. As more vehicles continue to fill, the run time will keep extending. This design approach allows ample time between vehicles to ensure that the compressor does not short cycle.

Based on the fleet size, fueling duration and gas pressure available, we have determined that a 230 standard cubic feet per minute (SCFM) compressor will be sufficient to handle the demand. A second compressor will provide redundancy so fueling can continue in the event a compressor is down for maintenance or repair. Compressors are programed to operate alternatively but could also be set up to run concurrently to provide additional throughput if demand requires.

The compressors are paired with a bank of 3 horizontally stacked 23 foot long ASME storage vessels. The vessels hold 34,713 SCF of gas at @ 4500 PSI. Because of the pressures required for a full fill on the vehicle, the usable storage for fueling is 35% or 12,150 SCF of usable storage. That is an equivalent of 84 DGE or 96 GGE of fill from storage without starting a compressor. A priority panel provides the logic to accept incoming gas from compressors, refill storage appropriately on a priority basis, and provide a cascade fill to the dispenser when a vehicle is calling for fuel. This panel is central to the compressors, storage and dispensers and is responsible for ensuring the system is fueling properly. The dispenser will be located indoors and have two hoses. One for large transit buses and a second smaller style connection for cutaway paratransit buses and other light to medium duty vehicles. This two hose dispenser will provide the flexibility for multiple types of vehicles. A backup dispenser will be provided outside next to the compound.

Prior to gas entering the compressor, it typically passes through a natural gas dryer. Although the dry gas analysis shows 0.000 moisture, sending dry gas into the compressor is crucial for compressor performance and longevity. Water can cause major damage through freezing and the lack of ability to compress if it gets into the pistons. Even though a manually regenerative dryer may never need to be regenerated, it makes sense to include the component in the system to ensure successful operation. This also provides for the contingency that a typical pipeline gas distribution system comes later as opposed to the Liquefied Natural Gas (LNG) that is being vaporized and provided to distribution at this site.

The addition of an emergency backup generator should be considered for the project. A 180 kilowatt (kW) generator to operate only one compressor is estimated to add $121,650 in equipment costs. This insures that the critical vehicle fueling operations are not disrupted in emergency situations.

CNG Station Cost Estimate

The high level opinion of probable cost for the CNG Station is estimated to be $2,175,722. The detailed cost estimate is attached to this report. The major cost components are:

a. CNG Compressor* Compound - $ 1,048,200

b. Fueling Systems Electrical - $186,626

c. Project Design, Construction, Contingency, etc. - $940,896

E. Projected Diesel, Gasoline and Natural Gas Costs

Estimating future diesel prices for 2018 and beyond in Alaska is highly uncertain. As excess supplies and global and United States oil production have lowered prices, most of the lower 48 states benefit from fuels refined from cheap crude oil from Texas or western Canada. Alaska's in-state refining uses relatively pricey Alaska North Slope crude, and out-of-state sources must take a long, expensive shipping route to Alaska. This typically causes higher fuel prices and more price volatility.

The transit system does not pay federal or state fuel taxes. In an effort to reduce America's dependence on foreign oil, reduce urban emissions and reduce greenhouse gases, the federal government offers a number of tax incentives to encourage the use of natural gas vehicles including a 50-cent tax credit per gasoline gallon equivalent (GGE) of compressed natural gas (CNG). The credit went into effect October 1, 2006 and originally expired December 31, 2009. Congress has extended this credit several times. The most recent extension of this incentive ended December 31, 2017 and was not extended beyond that in the recent tax bill. Although not a part of this financial analysis, if this provision were to be extended again in the future addition savings in annual fuel costs would be realized.

For the purposes of financial analysis we have reviewed the projections from the U.S. Energy Information Administration (EIA). The last Annual Energy Outlook 2018 (AEO2018) prepared by EIA was released in February 2018. The EIA presents a number of scenarios for future fuel cost projections with the EIA's normal or middle of the road "Reference Case" projecting average annual increases of 3.5% for gasoline and 3.7% for diesel through 2050. Projections show a steeper upward trend for both gasoline and diesel between 2018 and 2025 with the nominal price for both fuels increasing $1.40 - $1.50 a gallon. It is difficult to judge among the differing EIA scenarios and we have applied a conservative 2% annual inflation rate to both diesel and gasoline prices in the financial payback scenario. Using a projected 2020 price of $2.95 a gallon for diesel in Fairbanks and applying a 2% annual inflation rate results in a fiscal year 2039 projected price of $4.29 a gallon. A projected 2020 price of $3.25 a gallon for gasoline in Fairbanks with a 2% annual inflation rate applied results in a fiscal year 2039 projected price of $4.74 a gallon for gasoline.

Based upon AEO2018 natural gas production accounts for nearly 39% of all U.S. energy production by 2050. Natural gas production increases in every case projection, supporting higher levels of domestic consumption and natural gas exports. The U.S. is projected to become a net energy exporter by 2022. Henry Hub prices in the AEO2018 Reference case are 14% lower on average through 2050 than in the AEO2017 projections. EIA projects natural gas prices will continue to remain less expensive than gasoline or diesel fuel for the foreseeable future. Despite all this positive pricing information, natural gas prices in Fairbanks presents a special case. Currently there is no major pipeline supplying Fairbanks therefore all gas is shipped in as LNG and provided to the end user after vaporization. For

purposes of pricing we have relied on the Interior Gas Utility 2018 Financial Forecast and Pro Forma projected rates through 2031 documentation provided by Fairbanks Natural Gas. We have left the projected price unchanged from 2032 to 2039.

F. CNG Diesel/Gasoline Gallon Equivalent (DGE/GGE) Cost

Gasoline and diesel fuel are dispensed and sold on a liquid gallon basis. Compressed natural gas as a transportation fuel is sold on a gasoline gallon equivalent (GGE) basis. There is not an adopted standard for the dispensing of a diesel gallon equivalent (DGE). On a liquid gallon basis, diesel fuel has a higher energy content per gallon than unleaded gasoline. Natural gas as a commodity is priced on a 1000 cubic foot (MCF) or alternatively on a dekatherm (DTH) basis. A DTH is a unit of energy equal to 10 therms or one million British thermal units (MMBtu). There is approximately 1000 cubic feet in a dekatherm. A GGE of compressed natural gas is equal to 126.67 cubic feet of natural gas. A DGE of compressed natural gas is equal to 143.94 cubic feet. To more accurately reflect the cost comparison of the fuels, we have used a buildup approach to the cost per DGE of the CNG fuel. The DGE cost is based on natural gas cost, CNG equipment maintenance reserve, drying and compression costs.

The following Table V. CNG Cost Breakdown per DGE/GGE illustrates the breakdown of the estimated fiscal year 2020 initial baseline built-up CNG cost per DGE/GGE for the 20 year financial scenarios.

Table V. - CNG Cost Breakdown per DGE/GGE

Component	DGE	GGE
1. Natural Gas	$2.74	$2.42
2. Maintenance Reserve	$0.20	$0.18
3. Drying and Compression	$0.17	$0.15
Total Cost	**$3.11**	**$2.75**

1. Natural Gas Cost

The charge per MCF (1,000 cubic feet) of natural gas is $19.07 in FY20 as provided by the Interior Gas Utility. Prices for natural gas remain relatively flat throughout the 20 year scenario. One MCF contains approximately 6.95 diesel gallon equivalents (DGE) and 7.89 gasoline gallon equivalents (GGE).

2. Maintenance Reserve

The CNG fueling facility maintenance costs typically are based upon a gallon equivalent cost. Industry average maintenance costs run anywhere from $0.15 to $0.30 per gallon depending on the size and complexity of the station. This cost allocation covers the annual maintenance recommended by the manufacturer as well as the periodic overhauls of the compressors. Typical costs for this smaller size station proposed in this study are estimated to be $0.20 per DGE and $0.18 per GGE. It should be noted that this is not an annual expenditure but a maintenance reserve fund that would be set aside to fund periodic and future equipment maintenance. A MACS vehicle consuming 8,125 DGE of CNG would allocate an equivalent of $1,625 and a Van Tran vehicle consuming 2,821 GGE would allocate $508 per year towards current and future maintenance. Once CNG is fully implemented approximately $30,000 per year could be allocated for station maintenance using this approach.

3. Drying and Compression

Drying and compression typically includes the energy costs to run the station, primarily electric. This cost would typically be in the $0.10 - $0.15 per GGE/DGGE range. The Fairbanks electrical provider Golden Valley Electric Association (GVEA) has a higher $0.25 per kilowatt hour rate. We estimate this cost to be $017 per DGE and $0.15 per GGE. Operating the station in the evening has no impact as rates are unchanged by time of day.

G. CNG Safety, Specialized Training and Maintenance

Any fuel, including those used in motor vehicles, can be dangerous if handled improperly. Fuels contain energy, which is released when the fuel is ignited. Gasoline is a potentially dangerous fuel, but, by understanding how to handle it, we have learned to use it safely. The same is true of natural gas. Natural gas safely generates our electricity, heats our homes and cooks our meals. But, like gasoline, natural gas must be understood and respected in order to be used safely.

Natural gas is fuel that occurs naturally and requires very little processing before use. Chemically it normally consists of over 90% methane with smaller amounts of ethane, propane, butane, carbon dioxide and other trace gases. Pure methane has a very high octane rating (120-130) and the high methane content of natural gas in turn gives natural gas this same attribute. As with all vehicle fuels, natural gas can be used safely if the unique properties of the fuel are understood and common sense procedures are followed. In fact, natural gas has safety advantages compared to gasoline and diesel: it is non-toxic, and has no potential for ground or water contamination in the event of a fuel release.

Natural gas is lighter than air and dissipates rapidly when released. An odorant is added to provide a distinctive and intentionally disagreeable smell that is easy to recognize. The odor is detectable at one-fifth of the gas' lower flammability limit. Natural gas vehicles have an excellent safety record for two primary reasons: the properties of the fuel itself and the integrity of the natural gas vehicle and its fuel delivery system. Natural gas has a very limited range of flammability – it will not burn in concentrations below about 5% or above about 15% when mixed with air. Gasoline and diesel burn at much lower concentrations and ignite at lower temperatures.

Like conventional vehicles, CNG vehicles require proper maintenance. It is important to have trained technicians to properly maintain and service CNG vehicles. Because of the unique aspects of high pressure gas, the specialized equipment and the best practices required when transitioning to the CNG fuel source, additional training in the area of CNG fuel storage and fuel systems is recommended. Original equipment manufacturers generally fully back

the vehicles they produce with standard warranties, adequate parts inventory, and trained technicians available to assist you as needed. As CNG vehicles are introduced into the fleet, additional targeted CNG engine diagnostic and maintenance training will be a benefit to on-going operations. Overall training regimens for CNG vehicles should be continuous and on-going. It is recommended that continuing education and training programs be developed to reinforce any new standard operating procedures and safety requirements necessary for CNG vehicles.

1. Specialized CNG Training

A variety of training resources are available for compressed natural gas vehicles. A good source for training is the Natural Gas Vehicle Institute (NGVi). A variety of courses with various tuition fees (2018 early bird rates) are offered including: Level 1: NGV Essentials and Safety Practices $655, Level 2: CNG Fuel System Inspector Training $1,055, Level 3: Heavy-Duty NGV Maintenance and Diagnostics Training $1,695, and Essentials of CNG Station Operation and Maintenance $895. NGVi also provides the CNG Fuel System Inspector Certification Exam for $295 and is valid for a period of five years. More information can be found online at http://ngvi.com/public_registration.html. Most classes are 1-2 days and are offered in various locations. Not included in these fees are airline fares, hotel accommodations, and other travel expenses.

An important consideration and a vital part of fleet safety is ensuring the integrity of CNG storage and fuel systems. The National Highway Transportation Safety Administration (NHTSA) requires all on-board CNG storage cylinders manufactured after March 1995 be visually inspected every three years or 36,000 miles whichever comes first. The useful life of a CNG cylinder is dependent on the number of years it has been certified. Most CNG cylinders for onboard fuel storage are certified to either 15 or 20 years as per NGV2. In addition, cylinders should be inspected following any accident.

It would be recommended that you initially designate an adequate number of maintenance employees to work on CNG storage and fuel systems and have those employees receive CNG Fuel System Inspector training and certification before or

immediately after vehicles arrive and are put in service. As noted above the time required for this would generally be a one and a half to two day class and a certification exam. As a longer term strategy the consideration of modifying or adopting a new job classification such as "Fuel System Specialist" for vehicle inspections and/or a "Fueling System Technician" with training focused on maintaining the fueling station compression and dispensing equipment could be considered. Additional sources of information can also be found online or through networking with peer systems who have operated CNG transit fleets.

2. Vehicle Maintenance

Costs associated with a heavy duty dedicated CNG engine versus an equivalent diesel engine has narrowed. Although there is not good published data, it is generally accepted that the cost of maintaining a CNG engine is slightly higher than a pre-2010 diesel engine. The costs are similar however when compared to a post 2010 diesel engine and the increased maintenance requirements due to the 2010 EPA requirements. At the time of this study, there is not a large amount of additional reliable cost data to validate true maintenance costs of CNG versus diesel engines. Many published articles suggest little or no cost difference when coupled with good maintenance practices. We found no reliable data published for transit operations and have projected no additional costs for CNG vehicle maintenance in the feasibility cost model.

Dedicated natural gas engines in medium and heavy-duty diesel powered vehicles change from compression ignition to spark-ignition. Overall, maintenance for the ISL-G Cummins dedicated natural gas engine is similar to that of diesel engines, but there are a few key differences. Spark plugs will need to be replaced per the original equipment manufacturers recommended maintenance schedules. Motor oil specifically formulated for natural gas engines is required. If diesel engine oil is used, valve torching, piston scuffing and reduction in spark plug life will occur. For the ISL G, valve adjustment must be performed at intervals recommended by the engine manufacturer. This is an important step in achieving longer engine life.

Because the ISL-G does not require a Diesel Particulate Filter (DPF) or Selective Catalytic Reduction (SCR) systems, operators do not need to perform re-generations, and Diesel Exhaust Fluid (DEF) is not required. The fleet should save money by eliminating diesel emissions fluid, and diesel particulate filters and the regeneration issues sometimes accompanying the system with idling and low vehicles speeds. In the longer term, newer CNG engines have reduced maintenance requirements over their predecessors. In the case of the heavy duty transit vehicle, Cummins generally provides on-site training as required for mechanics maintaining the ISL-G engine that would be utilized in the buses.

Similarly light duty small and mid-sized buses are already spark ignition engines with natural gas conversions provided at a certified factory installation facility approved by Ford and General Motors. As such these vehicles carry all the same warranties as a gasoline vehicle. With the exception of the fuel storage system, general repairs procedures are substantially similar.

3. CNG Station Maintenance and Training

Like any other equipment, CNG station equipment requires preventive and corrective maintenance. Regular station maintenance will help prevent larger costs in the future. The station manufacturer will provide a comprehensive inspection and preventive maintenance program for the station equipment. The maintenance may be performed by facilities staff or be contracted to a third-party service provider. Although generally included, it is recommended that the transit system require the CNG station manufacturer provide on-site training on equipment to designated facilities staff, mechanic(s) or fueling system technician(s) that will include all maintenance and operations requirements for the station. Designated staff should work with a station trainer during initial station start up to understand all the required maintenance and operations requirements. After a station has been successfully in operation a few months, it is also recommended that the same staff receive training on EPA, MPCA, and local rules and regulations. Training consisting of 3-5 days of classroom and technical

training on compressor and fueling station system maintenance (if available) at the compressor manufacturing plant or training center is also encouraged. If the transit system wants this included in the procurement, it can be required at the time the specifications are issued for a station.

H. Environmental Benefits of CNG Vehicles

Fairbanks has the highest recorded levels of fine particulate matter ($PM_{2.5}$) in the nation. Its 2012–2014 design value is 139 µg/m3, which is 400% above the 35 µg/m3 National Ambient Air Quality Standard (NAAQS). No other community in the country has a greater air quality problem. The U.S. Environmental Protection Agency (EPA) reclassified the Fairbanks North Star Borough $PM_{2.5}$ nonattainment area from a Moderate to a Serious Area with an effective date of June 9, 2017. The reclassification by EPA triggered a requirement for the Alaska Department of Environmental Conservation (DEC) to update the area's State Implementation Plan (SIP) to include additional control measures that can be implemented to improve air quality.

The challenge of identifying, funding, and committing to implement the controls needed to produce the reduction required to attain the ambient $PM_{2.5}$ standard is huge. The severity of Fairbanks' air quality problem can be directly affected by the implementation of the transit bus CNG infrastructure project that will reduce directly emitted $PM_{2.5}$ and related precursor pollutants.

Information presented in the Reasonable Available Control Measure (RACM) analysis for the Moderate PM $PM_{2.5}$ SIP documented that home heating expenses in FNSB are two to three times higher than those seen in any other community with wood-burning controls. Unlike many communities, FNSB has limited access to natural gas and the dominant source of residential heating is fuel oil, which has had volatile price swings in recent years. While Fairbanks currently has natural gas service, it is capacity constrained; fewer than 400 homes currently heat with gas. Recognizing the need to provide a low-cost lower-emitting fuel alternative, the Alaska Industrial and Development Export Authority (AIDEA) and Interior

Gas Utility (IGU) Boards agreed to initiate construction of a 5.25 million gallon LNG tank to expand service to residential consumers starting in 2020. Construction on the project foundation began in January 2018 and has progressed rapidly. As of March 31, 2018, the foundation site was excavated and backfilled, and a thermos-syphon system was installed to maintain an appropriate ground temperature below the facility. Most recently, reinforcement steel has been placed and foundation forms constructed in preparation of pouring cement. The LNG storage project has a target completion date of fall 2019. Separate efforts have focused on ensuring long-term gas supply, liquefaction, transportation and distribution requirements. The IGU and AIDEA are also evaluating opportunities for supplying gas to local utilities and motor vehicles.

The Fairbanks Metropolitan Area Commuter System (MACS) is an integral part of the Fairbanks Metropolitan Area Transportation System (FMATS) and its efforts to enhance mobility in the community. It is also one of the control measures specified in the moderate area PM2.5 SIP. FNSB currently operates fifteen (15) heavy duty diesel transit buses for the MACS nine (9) fixed routes and a total of ten (10) E-350 and E-450 Ford cutaway chassis gasoline powered buses for the Grey Line and Van Tran paratransit demand response ADA service. An emissions analysis of converting these vehicles to CNG was prepared according to the recommended bus replacement plans specified in Appendix A-1.

The MACS vehicles have longer lifetimes than the Grey Line and Van Trans paratransit vehicles which results in more replacement cycles to cover comparable periods of operation. EPA's MOVES2014b model was used to generate the gram/mile emission factors for existing diesel and gasoline vehicles and replacement CNG vehicles in Appendix A-1. These values were combined with Borough supplied annual mileage values for each of the vehicles being replaced to quantify before and after emission estimates for the lifetime of each vehicle. The difference between these values was used to quantify the emission benefits of replacement. The final projected emission reduction results are presented in Exhibit A-8 and are summarized in Table VI. Expected Lifetime Benefits from CNG Vehicle Replacements on page 3-29 listing the separate pollutant (i.e., $PM_{2.5}$, VOC, CO and NOx) reductions for the MACS diesel powered buses and the gasoline powered Van Tran vehicles. The net benefit of replacing both vehicle fleets is also presented. As can be seen, significant

reductions are achieved for each of the criteria pollutants, which will aid Fairbanks maintain compliance with the ambient 8-hour CO standard (and related Maintenance Plan) and contribute reductions needed to aid compliance with the ambient 24-hour ambient $PM_{2.5}$ standard (a serious SIP is currently under development).

It should be noted that the estimates do not account for the principal benefit of transit service, which is the elimination of low-occupancy light-duty vehicle trips. In Alaska, gasoline-powered light-duty vehicles are a significant source of emissions because of the impact of arctic temperatures on cold-start emissions.

Table VI. - Expected Lifetime Benefits from CNG Vehicle Replacements (Total Tons)

Bus Fleet	$PM_{2.5}$	VOC	CO	NOx
Diesel – 15 Vehicles	0.242	0.672	-20.266	21.196
Gasoline – 10 Vehicles	0.107	2.394	41.299	0.706
Total Benefit	**0.348**	**3.065**	**21.033**	**21.902**

CNG vehicles also provide positive environmental aspects in reducing carbon dioxide (CO_2) emissions. The CO_2 emission coefficients of different fuels can be found on the U.S. Energy Information website:
http://www.eia.gov/environment/emissions/co2_vol_mass.cfm
The following a comparison of fuels relevant to this feasibility study. The following are the carbon dioxide emission coefficients by differing fuel types.

Carbon Dioxide Emission Coefficients

- **Natural Gas = 119.9 pounds per 1000 cubic feet (MCF)**
- **Natural Gas = 15.2 pounds per GGE**
- **Gasoline = 19.6 pounds per gallon**
- **Natural Gas = 17.3 pounds per DGE**
- **Diesel Fuel = 22.4 pounds per gallon (ultra-low sulfur)**

A gasoline gallon equivalent (GGE) is 126.67 cubic feet of natural gas. A diesel gallon equivalent (DGE) is 143.94 cubic feet of natural gas. A metric ton is 2,200 pounds. Each gallon of gasoline replaced with CNG represents a 4.4 pound or approximately 22.5% reduction in greenhouse gas emissions. Each gallon of diesel replaced with CNG represents a 5.14 pound or approximately 23% reduction in greenhouse gas emissions.

Each heavy duty CNG transit bus operated on CNG is projected to eliminate the use of 8,145 gallons of diesel annually. Replacing this with natural gas, the net impact is an annual reduction of 19 metric tons of CO_2 per bus. The annual reduction of 19 metric tons of CO_2 is equivalent to the annual greenhouse gas emissions (GHGE's) from 6.6 tons of waste sent to the landfill, the CO_2 emissions from 20,788 pounds of coal burned, the electricity use for 2.1 homes for a year, or the carbon sequestered by 492 tree seedlings grown for 10 years.

Over the life of the 20 year study period, dedicating all planned future large transit bus purchases to CNG operations results in displacement of 2,109,555 gallons of diesel resulting in a net Greenhouse Gas Emissions reduction of 4,929 metric tons of CO_2.

Each Van Tran cutaway CNG transit bus operated on CNG eliminates an average of 2,821 gallons of gasoline annually. Replacing this with natural gas, the net impact is an annual reduction of 5.65 metric tons of Carbon Dioxide (CO_2) per bus. The annual reduction of 5.65 metric tons of CO_2 is equivalent to the annual greenhouse gas emissions (GHGE's) from 2 tons of waste sent to the landfill, the CO_2 emissions from 6,182 pounds of coal burned, the electricity use for 1 homes for a year, or the carbon sequestered by 146 tree seedlings grown for 10 years.

Over the life of the 20 year study period, dedicating all planned future small cutaway transit bus purchases to CNG operations results in displacement of 476,749 gallons of gasoline resulting in a net Greenhouse Gas Emissions reduction of 955 metric tons of CO_2.

The combined MACS and Van Tran fleets operating on CNG over the 20 year study period results in a reduction of 5,884 metric tons of CO_2 or the equivalent annual greenhouse gas emissions (GHGE's) from 2,050 tons of waste sent to the landfill, the CO_2 emissions from 6,437,637 pounds of coal burned, the electricity use for 635 homes for a year, or the carbon sequestered by 152,491 tree seedlings grown for 10 years.

Findings

A life cycle analysis provides an economic analysis of the proposed capital investments that are expected in order to provide CNG vehicles while recognizing the change in operating costs of both the facilities and fleet. The long term financial analysis of return on investment demonstrates the capital outlays necessary to make facilities CNG ready, spend the additional resources to procure CNG fueled vehicles as outlined in the study, and build fueling station infrastructure. If the Borough goes ahead with the fleet transition to CNG it is recommended that the transit system construct a station on site. The most feasible location for a CNG station for operations is being determined by the current design process.

The 20 year financial feasibility of the switch to CNG vehicles is virtually cost neutral with full fleet implementation when CNG vehicle upcharges are included and facility and CNG station costs are excluded. When these costs are included in year one of the financial scenario, the 20 year net cash flow is -$2,730,873. The following is a recap of project costs and savings:

A. Project Costs and Savings

Table VII. Recap of CNG Fuel Savings vs. Increased Bus Costs and Table VIII. Facility and CNG Station Costs summarize the significant CNG costs/savings noted in the report.

Table VII. - Recap of CNG Fuel Savings vs. Increased Bus Costs

Category	Fuel Savings Utilizing CNG vs. Diesel /Gasoline	Less Added Bus Costs for CNG Engine, Fuel System, Tanks	* 20 Year Net Savings After CNG Bus Upcharges
Overall CNG Program	**$1,438,959**	(-$1,422,454)	**$16,504**
MACS Bus Fleet	$872,248	(-$891,311)	(-$19,063)
Van Tran Fleet	$566,711	(-$531,143)	$35,568

* Does Not Include Facility or CNG Fueling System Cost Estimates Listed Below.

Table VIII. - Facility and CNG Station Costs

Recommended	Equipment and Construction	Contingency and Other Project Costs	Total Estimate
Maintenance Repair, Indoor Fueling, Storage Upgrades	$371,419	$200,237	$571,656
CNG Fueling Station	$1,234,826	$940,896	$2,175,722

B. Cash Flow / Net Present Values

The annual cash flows are calculated as the net of capital outlays, increased vehicle costs, vehicle maintenance costs and projected fuel savings. The Net Present Value (NPV) of a project is determined by the summation of all annual cost savings (inflow cash) and all annual debts (outflow cash) over the life of the project stated in current dollars.

The total annual expenditure (savings & costs) is brought back to a present worth using a discount rate and is shown in the Cash Flows tables, which can found in the Appendix at the end of this study. A discount rate is defined as, "The rate of return required by an investor to accept the risks of a certain investment." This rate typically includes the inflation cost of money and the potential "risk-free" investment an owner could make. This rate differs based on the individual owner, their standard practice, and their tolerance for risk. Traditionally, this rate is typically greater than inflation. For the purpose of this analysis, a rate of 2.5% is assumed. The internal rate of return calculation is used for a series of cash flows represented by the numbers in values. These cash flows do not have to be even, and may be negative or positive based on net expenditures versus revenues. Cash flows must occur at regular intervals, such as annually in our case. The internal rate of return (IRR) is the interest rate received for an investment consisting of payments (negative values) and income (positive values) that occur at regular periods.

The project cash flow analysis scenarios include estimated capital outlays for the increased cost of CNG buses, necessary facility upgrades to meet CNG bus requirements for the maintenance repair, indoor fueling and service and bus storage areas, and construction of a new fast-fill CNG station. The Initial finding is that there are overall positive cash flows from conversion to CNG with the combined MACS and Van Tran scenarios when CNG vehicle upcharges are accounted for facility and fueling station costs are NOT assigned the CNG vehicle upcharges.

The Appendix contains the recommended fleet replacement schedules and fuel cost projections used for the separate cash flow analysis spreadsheets. A variety of scenarios are presented in this report demonstrating the net effect of CNG vehicle upcharges and fuels savings with and without the CNG facility and CNG fueling station costs.

Recommendations

The Borough requests a recommendation for future use of CNG at the Borough Transit Garage facility. The recommendation was to review the following options: 1) do not convert, 2) implement in the future, or 3) convert as part of the current project. Wendel recommends the Borough consider Option 2 with a few caveats. The Borough should consider the benefits of a future fleet wide implementation of CNG bus operations. Federal Transit Administration (FTA) and/or State of Alaska grant funding could be sought to cover the cost of the remaining requirements for a CNG compliant facility and CNG fueling station as part of the funding for Phase 2. With an initially well designed maintenance building, the required changes to make the facility CNG compatible are very reasonable for this project scope. In the short term it is advised the Borough proceed with Phase 1 design using the guidance provided in this report to have a facility that is easily upgraded in Phase 2 for overall CNG compliance. The following costs/items should be included in Phase 1:

1. Option A - Entire repair facility CNG compliant.
    a. $ 26,400 - added cost for 6 CNG compliant tailpipe exhaust reels
2. Fueling and service lane CNG compliant.
    a. $30,000 - compartmentalized fueling area - 2 Hour CMU End Wall Enclosures.
    b. $20,955 - Class 1, Division 2 (explosion proof) compliant wiring and lighting.
    c. NFPA 52 - 2016 update no longer requires deflagration panels. The Borough will need to adopt this code revision and get consensus with the Authorities Having Jurisdiction to determine if this will be required. If required, an estimate for the deflagration system would need to be prepared based on an approved design.

The total Phase 1 items recommended equal $77,355. For budgeting purposes additional project design, construction contingency, contractor fees and general conditions of $46,413 can be added for a total of $123,768.

Depending on the location of future installations of methane detection and controls it may be advisable to oversize conduit used for carbon monoxide (CO) and nitrogen dioxide (NO_2) monitoring as an alternative to running separate methane detection conduit in Phase 2. In regard to future emergency exhaust fan systems for the repair and fueling areas, future locations should be documented and adequate spacing provided between roof joists in the Phase 1 design and construction.

In the event CNG operations are started before Phase 2 is built, then the additional items including emergency exhaust fan systems and methane detection for the repair and fueling areas as well as the and the two hour rated coiling overhead doors for the fueling area would need to be installed before CNG buses arrive.

The move to begin transitioning the transit fleet to compressed natural gas (CNG) also warrants consideration as an environmental enhancement to vehicle use in transit operations. Again, the recommended strategy would be to buy new CNG transit buses as the older buses are replaced. The reliability of new heavy duty CNG transit buses has continued to improve. The introduction of new CNG engines, improved technology, and more reliable storage and dispensing systems has improved the operations and maintenance experience in all climates.

The business case analysis in this study comparing operations with CNG to diesel and gasoline provides positive fuel cost savings and reduced greenhouse gas emissions. The additional capital investments for the CNG facility upgrades and CNG station should be considered carefully in light of the other benefits. Securing additional grant funds for these upfront capital expense would be helpful to the overall project.

Because of the higher cost of natural gas in Fairbanks compared to the lower 48 states, the projected $2,840,392 cost for the facility upgrades and CNG station would likely not be covered by fuel savings unless natural gas prices were lowered or diesel and gasoline prices escalate further in which case the fuel cost savings could improve significantly. For example: in the 20 year scenario an $0.88 increase in the 2020 baseline diesel and gasoline price with 2% annual inflation generates the necessary fuel cost savings for the project to break even. Natural gas prices are projected to continue to remain very stable long term and could come down with an increase in Fairbanks natural gas users or the availability of pipeline gas to the Fairbanks area.

Should a decision be made to move ahead, strategic discussion with stakeholders and partners including the natural gas and electric providers, and bus manufacturers/small bus dealers should be undertaken early to insure infrastructure is adequately planned. A dedicated, on-site, fast-fill CNG fueling system is preferred. With the nine month to one year timeframe required to order and construct a CNG station, caution should be taken to ensure

that fueling station infrastructure is operational and coordinated with when CNG transit buses are ordered, received and placed into service. Staff administration, operator, and maintenance training should also be planned and completed prior to the introduction of CNG vehicles to the fleet.

Appendix

Fairbanks North Star Borough: MACS - Recommended 10 Year Bus Replacement Plan 2019-2028

Unit	Replaced	Year	LifeCycle	Replace	Make	Length	Model	2019 Due	2020 Due	2021 Due	2022 Due	2023 Due	2024 Due	2025 Due	2026 Due	2027 Due	2028 Due
71	---	2007	13	2020	Gillig	35	Low Floor	1	0								
72	---	2007	13	2020	Gillig	35	Low Floor	1	0								
73	---	2007	13	2020	Gillig	35	Low Floor	1	0								
74	---	2007	13	2020	Gillig	35	Low Floor	1	0								
710	---	2007	14	2021	Gillig	30	Low Floor	1	1	0							
75	---	2007	14	2021	Gillig	30	Low Floor	1	1	0							
76	---	2007	14	2021	Gillig	30	Low Floor	1	1	0							
77	---	2007	15	2022	Gillig	30	Low Floor	1	1	1	0						
78	---	2007	15	2022	Gillig	30	Low Floor	1	1	1	0						
79	---	2007	15	2022	Gillig	30	Low Floor	1	1	1	0						
141	---	2014	12	2026	Gillig	35	Low Floor	1	1	1	1	1	1	1	0		
142	---	2014	12	2026	Gillig	35	Low Floor	1	1	1	1	1	1	1	0		
143	---	2014	12	2026	Gillig	35	Low Floor	1	1	1	1	1	1	1	0		
Anch1	T945	2013	14	2027	New Flyer	40	Low Floor	1	1	1	1	1	1	1	1	0	
Anch2	T946	2013	14	2027	New Flyer	40	Low Floor	1	1	1	1	1	1	1	1	0	
144	71	2020	15	2035	Gillig	35	Low Floor		1	1	1	1	1	1	1	1	1
145	72	2020	15	2035	Gillig	35	Low Floor		1	1	1	1	1	1	1	1	1
146	73	2020	15	2035	Gillig	35	Low Floor		1	1	1	1	1	1	1	1	1
147	74	2020	15	2035	Gillig	35	Low Floor		1	1	1	1	1	1	1	1	1
148	710	2021	15	2036	Gillig	35	Low Floor			1	1	1	1	1	1	1	1
149	75	2021	15	2036	Gillig	35	Low Floor			1	1	1	1	1	1	1	1
150	76	2021	15	2036	Gillig	35	Low Floor			1	1	1	1	1	1	1	1
151	77	2022	15	2037	Gillig	35	Low Floor				1	1	1	1	1	1	1
152	78	2022	15	2037	Gillig	35	Low Floor				1	1	1	1	1	1	1
153	79	2022	15	2037	Gillig	35	Low Floor				1	1	1	1	1	1	1
154	141	2026	15	2041	Gillig	35	Low Floor								1	1	1
155	142	2026	15	2041	Gillig	35	Low Floor								1	1	1
156	143	2026	15	2041	Gillig	35	Low Floor								1	1	1
157	Anch1	2027	15	2042	Gillig	35	Low Floor									1	1
158	Anch2	2027	15	2042	Gillig	35	Low Floor									1	1
Vehicles Replaced								0	4	3	3	0	0	0	3	2	0
Total Vehicles								15	15	15	15	15	15	15	15	15	15
Required Peak								12	12	12	12	12	12	12	12	12	12
Spare Ratio								20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Per Vehicle Cost Diesel							Inflation Factor 2%	$ 490,196	$ 500,000	$ 510,000	$ 520,200	$ 530,604	$ 541,216	$ 552,040	$ 563,081	$ 574,343	$ 585,830
Per Vehicle Cost CNG Upcharge (Washington State Bid 2018)							CNG Upcharge $ 48,397	$ 538,593	$ 548,397	$ 558,397	$ 568,597	$ 579,001	$ 589,613	$ 600,437	$ 611,478	$ 622,740	$ 634,227
Note Only: Total Additional for CNG Upcharges								$ -	$ 193,588	$ 145,191	$ 145,191	$ -	$ -	$ -	$ 145,191	$ 96,794	$ -

Capital Improvement Plan - Annual Outlays	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Total Vehicle Replacement Cost Diesel	$ -	$ 2,000,000	$ 1,530,000	$ 1,560,600	$ -	$ -	$ -	$ 1,689,243	$ 1,148,686	$ -
Total Vehicle Replacement Cost CNG	$ -	$ 2,193,588	$ 1,675,191	$ 1,705,791	$ -	$ -	$ -	$ 1,834,434	$ 1,245,480	$ -
Local Share 20% Diesel	$ -	$ 400,000	$ 306,000	$ 312,120	$ -	$ -	$ -	$ 337,849	$ 229,737	$ -
Non-Local Share Diesel	$ -	$ 1,600,000	$ 1,224,000	$ 1,248,480	$ -	$ -	$ -	$ 1,351,394	$ 918,949	$ -
Local Share 20% CNG	$ -	$ 438,718	$ 335,038	$ 341,158	$ -	$ -	$ -	$ 366,887	$ 249,096	$ -
Non-Local Share CNG	$ -	$ 1,754,870	$ 1,340,153	$ 1,364,633	$ -	$ -	$ -	$ 1,467,547	$ 996,384	$ -

Fairbanks North Star Borough: MACS - Recommended 10 Year Bus Replacement Plan 2029-2038

Unit	Replaced	Year	LifeCycle	Replace	Make	Length	Model	2029 Due	2030 Due	2031 Due	2032 Due	2033 Due	2034 Due	2035 Due	2036 Due	2037 Due	2038 Due
144	71	2020	15	2035	Gillig	35	Low Floor	1	1	1	1	1	1	0			
145	72	2020	15	2035	Gillig	35	Low Floor	1	1	1	1	1	1	0			
146	73	2020	15	2035	Gillig	35	Low Floor	1	1	1	1	1	1	0			
147	74	2020	15	2035	Gillig	35	Low Floor	1	1	1	1	1	1	0			
148	710	2021	15	2036	Gillig	35	Low Floor	1	1	1	1	1	1	1	0		
149	75	2021	15	2036	Gillig	35	Low Floor	1	1	1	1	1	1	1	0		
150	76	2021	15	2036	Gillig	35	Low Floor	1	1	1	1	1	1	1	0		
151	77	2022	15	2037	Gillig	35	Low Floor	1	1	1	1	1	1	1	1	0	
152	78	2022	15	2037	Gillig	35	Low Floor	1	1	1	1	1	1	1	1	0	
153	79	2022	15	2037	Gillig	35	Low Floor	1	1	1	1	1	1	1	1	0	
154	141	2026	15	2041	Gillig	35	Low Floor	1	1	1	1	1	1	1	1	1	1
155	142	2026	15	2041	Gillig	35	Low Floor	1	1	1	1	1	1	1	1	1	1
156	143	2026	15	2041	Gillig	35	Low Floor	1	1	1	1	1	1	1	1	1	1
157	Anch1	2027	15	2042	Gillig	35	Low Floor	1	1	1	1	1	1	1	1	1	1
158	Anch2	2027	15	2042	Gillig	35	Low Floor	1	1	1	1	1	1	1	1	1	1
159	144	2035	15	2050	Gillig	35	Low Floor							1	1	1	1
160	145	2035	15	2050	Gillig	35	Low Floor							1	1	1	1
161	146	2035	15	2050	Gillig	35	Low Floor							1	1	1	1
162	147	2035	15	2050	Gillig	35	Low Floor							1	1	1	1
163	148	2036	15	2051	Gillig	35	Low Floor								1	1	1
164	149	2036	15	2051	Gillig	35	Low Floor								1	1	1
165	150	2036	15	2051	Gillig	35	Low Floor								1	1	1
166	151	2037	15	2052	Gillig	35	Low Floor									1	1
167	152	2037	15	2052	Gillig	35	Low Floor									1	1
168	153	2037	15	2052	Gillig	35	Low Floor									1	1
169	154	2041	15	2056	Gillig	35	Low Floor										future
170	155	2041	15	2056	Gillig	35	Low Floor										future
171	156	2041	15	2056	Gillig	35	Low Floor										future
172	157	2042	15	2057	Gillig	35	Low Floor										future
173	158	2042	15	2057	Gillig	35	Low Floor										future
Vehicles Replaced								0	0	0	0	0	0	4	3	3	0
Total Vehicles								15	15	15	15	15	15	15	15	15	15
Required Peak								12	12	12	12	12	12	12	12	12	12
Spare Ratio								20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Per Vehicle Cost Diesel						Inflation Factor 2%		$ 597,547	$ 609,498	$ 621,688	$ 634,122	$ 646,804	$ 659,740	$ 672,935	$ 686,394	$ 700,122	$ 714,124
Per Vehicle Cost CNG						CNG Upcharge	$ 48,397	$ 645,944	$ 657,895	$ 670,085	$ 682,519	$ 695,201	$ 708,137	$ 721,332	$ 734,791	$ 748,519	$ 762,521
Note Only: Total Additional for CNG Upcharges								$ -	$ -	$ -	$ -	$ -	$ -	$ 193,588	$ 145,191	$ 145,191	$ -

Capital Improvement Plan - Annual Outlays	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Total Vehicle Replacement Cost Diesel	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,691,740	$ 2,059,182	$ 2,100,366	$ -
Total Vehicle Replacement Cost CNG	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,885,328	$ 2,204,373	$ 2,245,557	$ -
Local Share 20% Diesel	$ -	$ -	$ -	$ -	$ -	$ -	$ 538,348	$ 411,836	$ 420,073	$ -
Non-Local Share Diesel	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,153,392	$ 1,647,346	$ 1,680,293	$ -
Local Share 20% CNG	$ -	$ -	$ -	$ -	$ -	$ -	$ 577,066	$ 440,875	$ 449,111	$ -
Non-Local Share CNG	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,308,262	$ 1,763,498	$ 1,796,446	$ -

Fairbanks North Star Borough: Van Tran - Recommended 10 Year Bus Replacement Plan 2019-2028

Unit	Replaced	Year	LifeCycle	Replace	Make	Length	Model	2019 Due	2020 Due	2021 Due	2022 Due	2023 Due	2024 Due	2025 Due	2026 Due	2027 Due	2028 Due
T144-13	---	2001	7	2008	Ford E450	25	StarTrans	0	Qty 3 - 2019 Cutaways Ordered as Gasoline								
VT143-17	---	2010	7	2017	Ford E450	25	StarTrans	0									
VT142-10	---	2011	7	2018	Ford E350	25	StarTrans	0									
VT2-11	---	2011	7	2018	Ford E350	25	StarTrans	1	0								
VT3-11	---	2011	7	2018	Ford E350	25	StarTrans	1	0								
VT4-11	---	2011	7	2018	Ford E350	25	StarTrans	1	1	0							
VT5-11	---	2011	7	2018	Ford E350	25	StarTrans	1	1	0							
VT6-11	---	2011	7	2018	Ford E350	25	StarTrans	1	1	1	0						
VT7-17	---	2017	7	2024	Ford E350	25	StarTrans	1	1	1	1	1	0				
T15-17	---	2017	7	2024	Ford E450	25	StarTrans	1	1	1	1	1	1	0			
2019-1	T144-13	2019	7	2026	Ford E350	25	StarTrans	1	1	1	1	1	1	1	0		
2019-2	VT143-17	2019	7	2026	Ford E350	25	StarTrans	1	1	1	1	1	1	1	0		
2019-3	VT142-10	2019	7	2026	Ford E350	25	StarTrans	1	1	1	1	1	1	1	0		
2020-1	VT2-11	2020	7	2027	Ford E350	25	StarTrans		1	1	1	1	1	1	1	0	
2020-2	VT3-11	2020	7	2027	Ford E350	25	StarTrans		1	1	1	1	1	1	1	0	
2021-1	VT4-11	2021	7	2028	Ford E350	25	StarTrans			1	1	1	1	1	1	1	0
2021-2	VT5-11	2021	7	2028	Ford E350	25	StarTrans			1	1	1	1	1	1	1	0
2022-1	VT6-11	2022	7	2029	Ford E350	25	StarTrans				1	1	1	1	1	1	1
2024-1	VT7-17	2024	7	2031	Ford E350	25	StarTrans						1	1	1	1	1
2025-1	T15-17	2025	7	2032	Ford E350	25	StarTrans							1	1	1	1
2026-1	2019-1	2026	7	2033	Ford E350	25	StarTrans								1	1	1
2026-2	2019-2	2026	7	2033	Ford E350	25	StarTrans								1	1	1
2026-3	2019-3	2026	7	2033	Ford E350	25	StarTrans								1	1	1
2027-1	2020-1	2027	7	2034	Ford E350	25	StarTrans									1	1
2027-1	2020-2	2027	7	2034	Ford E350	25	StarTrans									1	1
2028-1	2021-1	2028	7	2035	Ford E350	25	StarTrans										1
2028-2	2021-2	2028	7	2035	Ford E350	25	StarTrans										1
VT9-17	---	2017	5	2022	MV1	25	Van	1	1	1	1	1	1	1	1	1	1
Vehicles Replaced								3	2	2	1	0	1	1	3	2	2
Total Vehicles								11	11	11	11	11	11	11	11	11	11
Required Peak								7	7	7	7	7	7	7	7	7	7
Spare Ratio								36%	36%	36%	36%	36%	36%	36%	36%	36%	36%
Per VehicleVehicle Cost Gasoline					Inflation Factor 2%			$ 48,000	$ 48,960	$ 49,939	$ 50,938	$ 51,957	$ 52,996	$ 54,056	$ 55,137	$ 56,240	$ 57,365
Per VehicleVehicle Cost CNG					CNG Upcharge	$22,000		$ 70,000	$ 70,960	$ 71,939	$ 72,938	$ 73,957	$ 74,996	$ 76,056	$ 77,137	$ 78,240	$ 79,365
Note Only: Total Additional for CNG Upcharges								$ 66,000	$ 44,000	$ 44,000	$ 22,000	$ -	$ 22,000	$ 22,000	$ 66,000	$ 44,000	$ 44,000

Capital Improvement Plan - Annual Outlays	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Total Vehicle Replacement Cost Gasoline	$ 144,000	$ 97,920	$ 99,878	$ 50,938	$ -	$ 52,996	$ 54,056	$ 165,411	$ 112,480	$ 114,730
Total Vehicle Replacement Cost CNG	$ 210,000	$ 141,920	$ 143,878	$ 72,938	$ -	$ 74,996	$ 76,056	$ 231,411	$ 156,480	$ 158,730
Local Share 20% Gasoline	$ 28,800	$ 19,584	$ 19,976	$ 10,188	$ -	$ 10,599	$ 10,811	$ 33,082	$ 22,496	$ 22,946
Non-Local 80% Share Gasonline	$ 115,200	$ 78,336	$ 79,902	$ 40,750	$ -	$ 42,397	$ 43,245	$ 132,329	$ 89,984	$ 91,784
Local Share 20% CNG	$ 42,000	$ 28,384	$ 28,776	$ 14,588	$ -	$ 14,999	$ 15,211	$ 46,282	$ 31,296	$ 31,746
Non-Local Share CNG	$ 168,000	$ 113,536	$ 115,102	$ 58,350	$ -	$ 59,997	$ 60,845	$ 185,129	$ 125,184	$ 126,984

Fairbanks North Star Borough: Van Tran - Recommended 10 Year Bus Replacement Plan 2029-2038

Unit	Replaced	Year	LifeCycle	Replace	Make	Length	Model	2029 Due	2030 Due	2031 Due	2032 Due	2033 Due	2034 Due	2035 Due	2036 Due	2037 Due	2038 Due
2022-1	VT6-11	2022	7	2029	Ford E350	25	StarTrans	0									
2024-1	VT7-17	2024	7	2031	Ford E350	25	StarTrans	1	1	0							
2025-1	T15-17	2025	7	2032	Ford E350	25	StarTrans	1	1	1	0						
2026-1	2019-1	2026	7	2033	Ford E350	25	StarTrans	1	1	1	1	0					
2026-2	2019-2	2026	7	2033	Ford E350	25	StarTrans	1	1	1	1	0					
2026-3	2019-3	2026	7	2033	Ford E350	25	StarTrans	1	1	1	1	0					
2027-1	2020-1	2027	7	2034	Ford E350	25	StarTrans	1	1	1	1	1	0				
2027-1	2020-2	2027	7	2034	Ford E350	25	StarTrans	1	1	1	1	1	0				
2028-1	2021-1	2028	7	2035	Ford E350	25	StarTrans	1	1	1	1	1	1	0			
2028-2	2021-2	2028	7	2035	Ford E350	25	StarTrans	1	1	1	1	1	1	0			
2029-1	2022-1	2029	7	2036	Ford E350	25	StarTrans	1	1	1	1	1	1	1	0		
2031-1	2024-1	2031	7	2038	Ford E350	25	StarTrans			1	1	1	1	1	1	1	0
2032-1	2025-1	2032	7	2039	Ford E350	25	StarTrans				1	1	1	1	1	1	1
2033-1	2026-1	2033	7	2040	Ford E350	25	StarTrans					1	1	1	1	1	1
2033-2	2026-2	2033	7	2040	Ford E350	25	StarTrans					1	1	1	1	1	1
2033-3	2026-3	2033	7	2040	Ford E350	25	StarTrans					1	1	1	1	1	1
2034-1	2027-1	2034	7	2041	Ford E350	25	StarTrans						1	1	1	1	1
2034-2	2027-1	2034	7	2041	Ford E350	25	StarTrans						1	1	1	1	1
2035-1	2028-1	2035	7	2042	Ford E350	25	StarTrans							1	1	1	1
2035-2	2028-2	2035	7	2042	Ford E350	25	StarTrans							1	1	1	1
2036-1	2029-1	2036	7	2043	Ford E350	25	StarTrans								1	1	1
2038-1	2031-1	2038	7	2045	Ford E350	25	StarTrans										1
VT9-17	---	2017	5	2022	MV1	25	Van	1	1	1	1	1	1	1	1	1	1
Vehicles Replaced								1	0	1	1	3	2	2	1	0	1
Total Vehicles								11	11	11	11	11	11	11	11	11	11
Required Peak								7	7	7	7	7	7	7	7	7	7
Spare Ratio								36%	36%	36%	36%	36%	36%	36%	36%	36%	36%
Per Vehicle Cost Gasoline						Inflation Factor 2%		$ 57,365	$ 58,512	$ 59,682	$ 60,876	$ 62,094	$ 63,336	$ 64,603	$ 65,895	$ 67,213	$ 68,557
Per Vehicle Cost CNG						CNG Upcharge	$22,000	$ 79,365	$ 80,512	$ 81,682	$ 82,876	$ 84,094	$ 85,336	$ 86,603	$ 87,895	$ 89,213	$ 90,557
Note Only: Total Additional for CNG Upcharges								$ 22,000	$ -	$ 22,000	$ 22,000	$ 66,000	$ 44,000	$ 44,000	$ 22,000	$ -	$ 22,000

Capital Improvement Plan - Annual Outlays	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Total Vehicle Replacement Cost Gasoline	$ 57,365	$ -	$ 59,682	$ 60,876	$ 186,282	$ 126,672	$ 129,206	$ 65,895	$ -	$ 68,557
Total Vehicle Replacement Cost CNG	$ 79,365	$ -	$ 81,682	$ 82,876	$ 252,282	$ 170,672	$ 173,206	$ 87,895	$ -	$ 90,557
Local Share 20% Gasoline	$ 11,473	$ -	$ 11,936	$ 12,175	$ 37,256	$ 25,334	$ 25,841	$ 13,179	$ -	$ 13,711
Non-Local Share Gasonline	$ 45,892	$ -	$ 47,746	$ 48,701	$ 149,026	$ 101,338	$ 103,365	$ 52,716	$ -	$ 54,846
Local Share 20% CNG	$ 15,873	$ -	$ 16,336	$ 16,575	$ 50,456	$ 34,134	$ 34,641	$ 17,579	$ -	$ 18,111
Non-Local Share CNG	$ 63,492	$ -	$ 65,346	$ 66,301	$ 201,826	$ 136,538	$ 138,565	$ 70,316	$ -	$ 72,446

Fairbanks North Star Borough; MACS and Van Tran
Fleet Replacement and Fuel Cost Projections

FY In Service	CNG Buses	CNG Upcharge	Diesel Gallons	Cumulative Gallons	* Diesel $/Gal	# NG $/DGE	Spread / Savings	CNG Cutaways	CNG Upcharge	Gasoline Gallons	Cumulative Gallons	* Gasoline $/Gal	# NG $/GGE	Spread / Savings
2020	4	$ 193,588	32,580	32,580	2.95	3.11	(0.16)	2	$ 44,000	5,642	5,642	3.25	2.75	0.50
2021	3	$ 145,191	24,435	57,015	3.01	2.90	0.11	2	$ 44,000	5,642	11,284	3.32	2.55	0.77
2022	3	$ 145,191	24,435	81,450	3.07	2.90	0.17	1	$ 22,000	2,821	14,105	3.39	2.55	0.84
2023		$ -	-	81,450	3.13	2.90	0.23		$ -	-	14,105	3.46	2.55	0.91
2024		$ -	-	81,450	3.19	2.96	0.23	1	$ 22,000	2,821	16,926	3.53	2.61	0.92
2025		$ -	-	81,450	3.25	3.04	0.21	1	$ 22,000	2,821	19,747	3.60	2.68	0.92
2026	3	$ 145,191	24,435	105,885	3.32	3.10	0.22	3	$ 66,000	8,463	28,210	3.67	2.73	0.94
2027	2	$ 96,794	16,290	122,175	3.39	3.13	0.26	2	$ 44,000	-	28,210	3.74	2.75	0.99
2028		$ -	-	122,175	3.46	3.20	0.26	2	$ 44,000	-	28,210	3.81	2.82	0.99
2029		$ -	-	122,175	3.53	3.28	0.25	1	$ 22,000	-	28,210	3.89	2.90	0.99
2030		$ -	-	122,175	3.60	3.33	0.27		$ -	-	28,210	3.97	2.93	1.04
2031		$ -	-	122,175	3.67	3.38	0.29	1	$ 22,000	-	28,210	4.05	2.98	1.07
2032		$ -	-	122,175	3.74	3.38	0.36	1	$ 22,000	-	28,210	4.13	2.98	1.15
2033		$ -	-	122,175	3.81	3.38	0.43	3	$ 66,000	-	28,210	4.21	2.98	1.23
2034		$ -	-	122,175	3.89	3.38	0.51	2	$ 37,714	-	28,210	4.29	2.98	1.31
2035	4	$ 80,662	-	122,175	3.97	3.38	0.59	2	$ 31,429	-	28,210	4.38	2.98	1.40
2036	3	$ 48,397	-	122,175	4.05	3.38	0.67	1	$ 12,571	-	28,210	4.47	2.98	1.49
2037	3	$ 36,298	-	122,175	4.13	3.38	0.75		$ -	-	28,210	4.56	2.98	1.58
2038		$ -	-	122,175	4.21	3.38	0.83	1	$ 6,286	-	28,210	4.65	2.98	1.67
2039		$ -	-	122,175	4.29	3.38	0.91	1	$ 3,143	-	28,210	4.74	2.98	1.76
TOTALS	25	891,311		2,109,555				27	$ 531,143		476,749			

Baseline Diesel: $ 2.950 * Increases 2% Annually

CNG Vehicle Upcharge MACS $ 48,397

Average Annual Diesel Per Vehicle 8,145

CNG DGE 143.94 CF

CNG GGE 126.67 CF

Baseline Gasoline: $ 3.250 * Increases 2.0% Annually

CNG Vehicle Upcharge Van Tran $ 22,000

Average Annual Gas Per Vehicle 2,821

Fairbanks North Star Borough
MACS Service CNG Fleet
Detailed Project Cash Flow

	A_1	A_2	A	B	C	D = A + B + C	E	F	G	H = E + F + G	I = D + H
Year	[1]Annual Fuel Costs Diesel	[1]Annual Fuel Costs CNG	[1]Annual Fuel Cost Savings	[2]Annual Fleet Maintenance Costs	[2]Annual Facility Maintenance Costs	Total Change In Operational Expenditures	[3]Incremental CNG Fleet Expenditures	[4] Facility CNG Premium Expenditure	[5]Fueling Facility Expenditure	Total Capital Expenditures	Net Annual Cash Flow
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1	$96,111	$101,324	$5,213	$0	$0	$5,213	$193,588	$0	$0	$193,588	-$198,801
2	$171,615	$165,344	-$6,272	$0	$0	-$6,272	$145,191	$0	$0	$145,191	-$138,919
3	$250,052	$236,205	-$13,847	$0	$0	-$13,847	$145,191	$0	$0	$145,191	-$131,345
4	$254,939	$236,205	-$18,734	$0	$0	-$18,734	$0	$0	$0	$0	$18,734
5	$259,826	$241,092	-$18,734	$0	$0	-$18,734	$0	$0	$0	$0	$18,734
6	$264,713	$247,608	-$17,105	$0	$0	-$17,105	$0	$0	$0	$0	$17,105
7	$351,538	$328,244	-$23,295	$0	$0	-$23,295	$145,191	$0	$0	$145,191	-$121,896
8	$414,173	$382,408	-$31,766	$0	$0	-$31,766	$96,794	$0	$0	$96,794	-$65,029
9	$422,726	$390,960	-$31,766	$0	$0	-$31,766	$0	$0	$0	$0	$31,766
10	$431,278	$400,734	-$30,544	$0	$0	-$30,544	$0	$0	$0	$0	$30,544
11	$439,830	$406,843	-$32,987	$0	$0	-$32,987	$0	$0	$0	$0	$32,987
12	$448,382	$412,952	-$35,431	$0	$0	-$35,431	$0	$0	$0	$0	$35,431
13	$456,935	$412,952	-$43,983	$0	$0	-$43,983	$0	$0	$0	$0	$43,983
14	$465,487	$412,952	-$52,535	$0	$0	-$52,535	$0	$0	$0	$0	$52,535
15	$475,261	$412,952	-$62,309	$0	$0	-$62,309	$0	$0	$0	$0	$62,309
16	$485,035	$412,952	-$72,083	$0	$0	-$72,083	$80,662	$0	$0	$80,662	-$8,578
17	$494,809	$412,952	-$81,857	$0	$0	-$81,857	$48,397	$0	$0	$48,397	$33,460
18	$504,583	$412,952	-$91,631	$0	$0	-$91,631	$36,298	$0	$0	$36,298	$55,334
19	$514,357	$412,952	-$101,405	$0	$0	-$101,405	$0	$0	$0	$0	$101,405
20	$524,131	$412,952	-$111,179	$0	$0	-$111,179	$0	$0	$0	$0	$111,179
Totals	$7,725,777	$6,853,529	-$872,248	$0	$0	-$872,248	$891,311	$0	$0	$891,311	-$19,063

[1] Differential between diesel or gasoline and CNG.

[2] No Additional costs associated with the maintenance of CNG vehicles.

[3] Incremental cost for purchasing CNG buses versus Diesel or Gasoline.

[4] Cost for Building CNG Ready Maintenance, Storage, and Indoor Fueling & Service.

[5] Costs for constructing CNG Fueling Station

Internal Rate of Return: 0.0%

[6] Net Present Value N.A.

[6] Assumes Discount Rate of 2.5%

Fairbanks North Star Borough
Van Tran Service CNG Fleet
Detailed Project Cash Flow

	A_1	A_2	A	B	C	D = A + B + C	E	F	G	H = E + F + G	I = D + H
Year	[1]Annual Fuel Costs Diesel	[1]Annual Fuel Costs CNG	[1]Annual Fuel Cost Savings	[2]Annual Fleet Maintenance Costs	[2]Annual Facility Maintenance Costs	Total Change In Operational Expenditures	[3]Incremental CNG Fleet Expenditures	[4] Facility Renovation Expenditure	[5]Fueling Facility Expenditure	Total Capital Expenditures	Net Annual Cash Flow
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1	$18,337	$15,516	-$2,821	$0	$0	-$2,821	$44,000	$0	$0	$44,000	-$41,179
2	$37,463	$28,774	-$8,689	$0	$0	-$8,689	$44,000	$0	$0	$44,000	-$35,311
3	$47,816	$35,968	-$11,848	$0	$0	-$11,848	$22,000	$0	$0	$22,000	-$10,152
4	$48,803	$35,968	-$12,836	$0	$0	-$12,836	$0	$0	$0	$0	$12,836
5	$59,749	$44,177	-$15,572	$0	$0	-$15,572	$22,000	$0	$0	$22,000	-$6,428
6	$71,089	$52,922	-$18,167	$0	$0	-$18,167	$22,000	$0	$0	$22,000	-$3,833
7	$103,531	$77,013	-$26,517	$0	$0	-$26,517	$66,000	$0	$0	$66,000	-$39,483
8	$105,505	$77,578	-$27,928	$0	$0	-$27,928	$44,000	$0	$0	$44,000	-$16,072
9	$107,480	$79,552	-$27,928	$0	$0	-$27,928	$44,000	$0	$0	$44,000	-$16,072
10	$109,737	$81,809	-$27,928	$0	$0	-$27,928	$22,000	$0	$0	$22,000	$5,928
11	$111,994	$82,655	-$29,338	$0	$0	-$29,338	$0	$0	$0	$0	$29,338
12	$114,251	$84,066	-$30,185	$0	$0	-$30,185	$22,000	$0	$0	$22,000	$8,185
13	$116,507	$84,066	-$32,442	$0	$0	-$32,442	$22,000	$0	$0	$22,000	$10,442
14	$118,764	$84,066	-$34,698	$0	$0	-$34,698	$66,000	$0	$0	$66,000	-$31,302
15	$121,021	$84,066	-$36,955	$0	$0	-$36,955	$37,714	$0	$0	$37,714	-$759
16	$123,560	$84,066	-$39,494	$0	$0	-$39,494	$31,429	$0	$0	$31,429	$8,065
17	$126,099	$84,066	-$42,033	$0	$0	-$42,033	$12,571	$0	$0	$12,571	$29,461
18	$128,638	$84,066	-$44,572	$0	$0	-$44,572	$0	$0	$0	$0	$44,572
19	$131,177	$84,066	-$47,111	$0	$0	-$47,111	$6,286	$0	$0	$6,286	$40,825
20	$133,715	$84,066	-$49,650	$0	$0	-$49,650	$3,143	$0	$0	$3,143	$46,507
Totals	$1,935,234	$1,368,524	-$566,711	$0	$0	-$566,711	$531,143	$0	$0	$531,143	$35,568

[1] Differential between diesel or gasoline and CNG.

[2] No Additional costs associated with the maintenance of CNG vehicles.

[3] Incremental cost for purchasing CNG buses versus Diesel or Gasoline.

[4] Cost for Building CNG Ready Maintenance, Storage, and Indoor Fueling & Service.

[5] Costs for constructing CNG Fueling Station

Internal Rate of Return: 0.0%

[6] Net Present Value N.A.

[6] Assumes Discount Rate of 2.5%

Fairbanks North Star Borough
MACS & Van Tran Service CNG Fleet
Detailed Project Cash Flow - Without Facility and CNG Station Costs

	A_1	A_2	A	B	C	D = A + B + C	E	F	G	H = E + F + G	I = D + H
Year	[1]Annual Fuel Costs Diesel	[1]Annual Fuel Costs CNG	[1]Annual Fuel Cost Savings	[2]Annual Fleet Maintenance Costs	[2]Annual Facility Maintenance Costs	Total Change In Operational Expenditures	[3]Incremental CNG Fleet Expenditures	[4] Facility Renovation Expenditure	[5]Fueling Facility Expenditure	Total Capital Expenditures	Net Annual Cash Flow
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1	$114,448	$116,839	$2,392	$0	$0	$2,392	$237,588	$0	$0	$237,588	-$239,980
2	$209,078	$194,118	-$14,960	$0	$0	-$14,960	$189,191	$0	$0	$189,191	-$174,231
3	$297,867	$272,173	-$25,695	$0	$0	-$25,695	$167,191	$0	$0	$167,191	-$141,496
4	$303,742	$272,173	-$31,569	$0	$0	-$31,569	$0	$0	$0	$0	$31,569
5	$319,574	$285,269	-$34,305	$0	$0	-$34,305	$22,000	$0	$0	$22,000	$12,305
6	$335,802	$300,530	-$35,272	$0	$0	-$35,272	$22,000	$0	$0	$22,000	$13,272
7	$455,069	$405,257	-$49,812	$0	$0	-$49,812	$211,191	$0	$0	$211,191	-$161,379
8	$519,679	$459,985	-$59,693	$0	$0	-$59,693	$140,794	$0	$0	$140,794	-$81,101
9	$530,206	$470,512	-$59,693	$0	$0	-$59,693	$44,000	$0	$0	$44,000	$15,693
10	$541,015	$482,543	-$58,472	$0	$0	-$58,472	$22,000	$0	$0	$22,000	$36,472
11	$551,824	$489,498	-$62,326	$0	$0	-$62,326	$0	$0	$0	$0	$62,326
12	$562,633	$497,017	-$65,615	$0	$0	-$65,615	$22,000	$0	$0	$22,000	$43,615
13	$573,442	$497,017	-$76,425	$0	$0	-$76,425	$22,000	$0	$0	$22,000	$54,425
14	$584,251	$497,017	-$87,234	$0	$0	-$87,234	$66,000	$0	$0	$66,000	$21,234
15	$596,282	$497,017	-$99,264	$0	$0	-$99,264	$37,714	$0	$0	$37,714	$61,550
16	$608,595	$497,017	-$111,577	$0	$0	-$111,577	$112,090	$0	$0	$112,090	-$513
17	$620,907	$497,017	-$123,890	$0	$0	-$123,890	$60,968	$0	$0	$60,968	$62,922
18	$633,220	$497,017	-$136,203	$0	$0	-$136,203	$36,298	$0	$0	$36,298	$99,905
19	$645,533	$497,017	-$148,516	$0	$0	-$148,516	$6,286	$0	$0	$6,286	$142,230
20	$657,846	$497,017	-$160,829	$0	$0	-$160,829	$3,143	$0	$0	$3,143	$157,686
Totals	$9,661,011	$8,222,052	-$1,438,959	$0	$0	-$1,438,959	$1,422,454	$0	$0	$1,422,454	$16,504

[1] Differential between diesel or gasoline and CNG.

[2] No Additional costs associated with the maintenance of CNG vehicles.

[3] Incremental cost for purchasing CNG buses versus Diesel or Gasoline.

[4] Cost for Building CNG Ready Maintenance, Storage, and Indoor Fueling & Service.

[5] Costs for constructing CNG Fueling Station

Internal Rate of Return: 0.0%

[6] Net Present Value N.A.

[6] Assumes Discount Rate of 2.5%

Fairbanks North Star Borough
MACS & Van Tran Service CNG Fleet
Detailed Project Cash Flow - All Capital Costs

	A_1	A_2	A	B	C	D = A + B + C	E	F	G	H = E + F + G	I = D + H
Year	[1]Annual Fuel Costs Diesel	[1]Annual Fuel Costs CNG	[1]Annual Fuel Cost Savings	[2]Annual Fleet Maintenance Costs	[2]Annual Facility Maintenance Costs	Total Change In Operational Expenditures	[3]Incremental CNG Fleet Expenditures	[4] Facility Renovation Expenditure	[5]Fueling Facility Expenditure	Total Capital Expenditures	Net Annual Cash Flow
0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1	$114,448	$116,839	$2,392	$0	$0	$2,392	$237,588	$571,655	$2,175,722	$2,984,965	-$2,987,357
2	$209,078	$194,118	-$14,960	$0	$0	-$14,960	$189,191	$0	$0	$189,191	-$174,231
3	$297,867	$272,173	-$25,695	$0	$0	-$25,695	$167,191	$0	$0	$167,191	-$141,496
4	$303,742	$272,173	-$31,569	$0	$0	-$31,569	$0	$0	$0	$0	$31,569
5	$319,574	$285,269	-$34,305	$0	$0	-$34,305	$22,000	$0	$0	$22,000	$12,305
6	$335,802	$300,530	-$35,272	$0	$0	-$35,272	$22,000	$0	$0	$22,000	$13,272
7	$455,069	$405,257	-$49,812	$0	$0	-$49,812	$211,191	$0	$0	$211,191	-$161,379
8	$519,679	$459,985	-$59,693	$0	$0	-$59,693	$140,794	$0	$0	$140,794	-$81,101
9	$530,206	$470,512	-$59,693	$0	$0	-$59,693	$44,000	$0	$0	$44,000	$15,693
10	$541,015	$482,543	-$58,472	$0	$0	-$58,472	$22,000	$0	$0	$22,000	$36,472
11	$551,824	$489,498	-$62,326	$0	$0	-$62,326	$0	$0	$0	$0	$62,326
12	$562,633	$497,017	-$65,615	$0	$0	-$65,615	$22,000	$0	$0	$22,000	$43,615
13	$573,442	$497,017	-$76,425	$0	$0	-$76,425	$22,000	$0	$0	$22,000	$54,425
14	$584,251	$497,017	-$87,234	$0	$0	-$87,234	$66,000	$0	$0	$66,000	$21,234
15	$596,282	$497,017	-$99,264	$0	$0	-$99,264	$37,714	$0	$0	$37,714	$61,550
16	$608,595	$497,017	-$111,577	$0	$0	-$111,577	$112,090	$0	$0	$112,090	-$513
17	$620,907	$497,017	-$123,890	$0	$0	-$123,890	$60,968	$0	$0	$60,968	$62,922
18	$633,220	$497,017	-$136,203	$0	$0	-$136,203	$36,298	$0	$0	$36,298	$99,905
19	$645,533	$497,017	-$148,516	$0	$0	-$148,516	$6,286	$0	$0	$6,286	$142,230
20	$657,846	$497,017	-$160,829	$0	$0	-$160,829	$3,143	$0	$0	$3,143	$157,686
Totals	$9,661,011	$8,222,052	-$1,438,959	$0	$0	-$1,438,959	$1,422,454	$571,655	$2,175,722	$4,169,831	-$2,730,873

[1] Differential between diesel or gasoline and CNG.

[2] No Additional costs associated with the maintenance of CNG vehicles.

[3] Incremental cost for purchasing CNG buses versus Diesel or Gasoline.

[4] Cost for Building CNG Ready Maintenance, Storage, and Indoor Fueling & Service.

[5] Costs for constructing CNG Fueling Station

Internal Rate of Return: 0.0%

[6] Net Present Value N.A.

[6] Assumes Discount Rate of 2.5%

APPENDIX A-4

OPINION OF PROBABLE COST WORKSHEET

Project Title:	DA Fairbanks AK Transit Garage	Project No.:	383901
Estimate:	**Fairbanks Operations and Maintenance Facility - Option A**	Revision Date:	08/15/2018
Location:	Fairbanks, AK	Orig. Date:	05/31/2018
Description:	Option A: Entire Repair Facility with CNG Upgrades	Estimated by:	CBC, RB1, SRN
File Name:	CNG Feasibility Study Estimates.xlsx	Checked by:	JTW
		Approved by:	SRN

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MAT.& LAB.	ESTIMATED AMOUNT
	Option A: Entire Repair Facility with CNG Upgrades				
	Methane Detectors, conduit, wire and prog. (CNG premium only)	28,544	ea	$ 4.40	$ 125,594
	Emergency Exhaust Fan System @ 9,000 cfm	5	ea	$ 9,200	$ 46,000
	Controls	1	ls	$ 18,500	$ 18,500
	Tailpipe Exhaust Reels, Hoses, Controls (CNG Premium only)	10	ea	$ 4,400.00	$ 44,000
			Sub Total		$ 234,094
	Option A: Entire Repair Facility with CNG Upgrades			**Project Sub Total:**	$ 234,094
25.0%	Alaska Escalation				$ 58,524
20.0%	Construction Contingency				$ 46,819
0.0%	Design				$ -
5.0%	Genaral Contractor Fee				$ 11,705
10.0%	General Conditions				$ 23,409
				ADDITIONAL PROJECT CHARGES	$ 140,456
	Fairbanks Operations and Maintenance Facility - Option A			**TOTAL**	**$ 374,550**

APPENDIX A-4

OPINION OF PROBABLE COST WORKSHEET

Project Title:	DA Fairbanks AK Transit Garage	Project No.:	383901
Estimate:	**Fairbanks Operations and Maintenance Facility - Option B**	Revision Date:	08/15/2018
Location:	Fairbanks, AK	Orig. Date:	05/31/2018
Description:	Option B: Two Repair Bays with CNG Upgrades	Estimated by:	CBC, RB1, SRN
File Name:	CNG Feasibility Study Estimates.xlsx	Checked by:	JTW
		Approved by:	SRN

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MAT.& LAB.	ESTIMATED AMOUNT
	Option B: Two Repair Bays with CNG upgrades				
	Methane Detectors, conduit, wire and prog. (CNG premium only)	4,745	sf	$ 4.40	$ 20,878
	Emergency Exhuast Fan System @ 10,000 cfm	1	ea	$ 9,500	$ 9,500
	Controls	1	ls	$ 8,400	$ 8,400
	Tailpipe Exhaust Reels, Hoses, Controls (CNG Premium only)	2	ea	$ 4,400	$ 8,800
	2-HR CMU Enclosure	1	ls	$ 170,000	$ 170,000
	2-HR Coiling Overhead Doors	2	ea	$ 15,000	$ 30,000
			Sub Total		$ 247,578
	Option B: Two Repair Bays with CNG Upgrades			**Project Sub Total:**	$ 247,578
25.0%	Alaska Escalation				$ 61,895
20.0%	Construction Contingency				$ 49,516
0.0%	Design				$ -
5.0%	Genaral Contractor Fee				$ 12,379
10.0%	General Conditions				$ 24,758
				ADDITIONAL PROJECT CHARGES	$ 148,547
	Fairbanks Operations and Maintenance Facility - Option B			**TOTAL**	**$ 396,125**

APPENDIX A-4

OPINION OF PROBABLE COST WORKSHEET

Project Title:	DA Fairbanks AK Transit Garage	Project No.:	383901
Estimate:	**Fairbanks Operations and Maintenance Facility - Indoor CNG Fueling**	Revision Date:	08/15/2018
Location:	Fairbanks, AK	Orig. Date:	05/31/2018
Description:	Indoor CNG Fueling	Estimated by:	CBC, RB1, SRN
File Name:	CNG Feasibility Study Estimates.xlsx	Checked by:	JTW
		Approved by:	SRN

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MAT.& LAB.	ESTIMATED AMOUNT
	Indoor CNG Fueling & Service Lane				
	Methane Detectors, conduit, wire and prog. (CNG premium only)	1,097	sf	$ 4.40	$ 4,827
	Emergency Exhuast Fan System @ 2500 cfm	1	ea	$ 7,800	$ 7,800
	Controls	1	ea	$ 8,800	$ 8,800
	Class 1, Division 2 compliant wiring Method (CNG Premium Only	1,097	sf	$ 15	$ 16,455
	Class 1, Division 2 Compliant Lighting (CNG Premium Only)	6	ea	$ 750	$ 4,500
	Fire Alarm (Flame Detectors)	2	ea	$ 1,500	$ 3,000
	Compartmentalize Fueling Area - 2 Hr CMU End Wall Enclosures	1	ea	$ 30,000	$ 30,000
	Two Hour Rated Coiling Overhead Doors	2	ea	$ 15,000	$ 30,000
			Sub Total		$ 75,382
	Indoor CNG Fueling Costs			**Project Sub Total:**	$ 75,382
25.0%	Alaska Escalation				$ -
20.0%	Construction Contingency				$ 15,076
0.0%	Design				$ -
5.0%	Genaral Contractor Fee				$ -
10.0%	General Conditions				$ 7,538
				ADDITIONAL PROJECT CHARGES	$ 22,614
	Fairbanks Operations and Maintenance Facility - Indoor CNG Fueling			**TOTAL**	**$ 97,996**

APPENDIX A-4

OPINION OF PROBABLE COST WORKSHEET

Project Title:	DA Fairbanks AK Transit Garage	Project No.:	383901
Estimate:	**Fairbanks Operations and Maintenance Facility - Storage Detection**	Revision Date:	08/15/2018
Location:	Fairbanks, AK	Orig. Date:	05/31/2018
Description:	Optional Methane Detection for Bus Storage Areas	Estimated by:	CBC, RB1, SRN
File Name:	CNG Feasibility Study Estimates.xlsx	Checked by:	JTW
		Approved by:	SRN

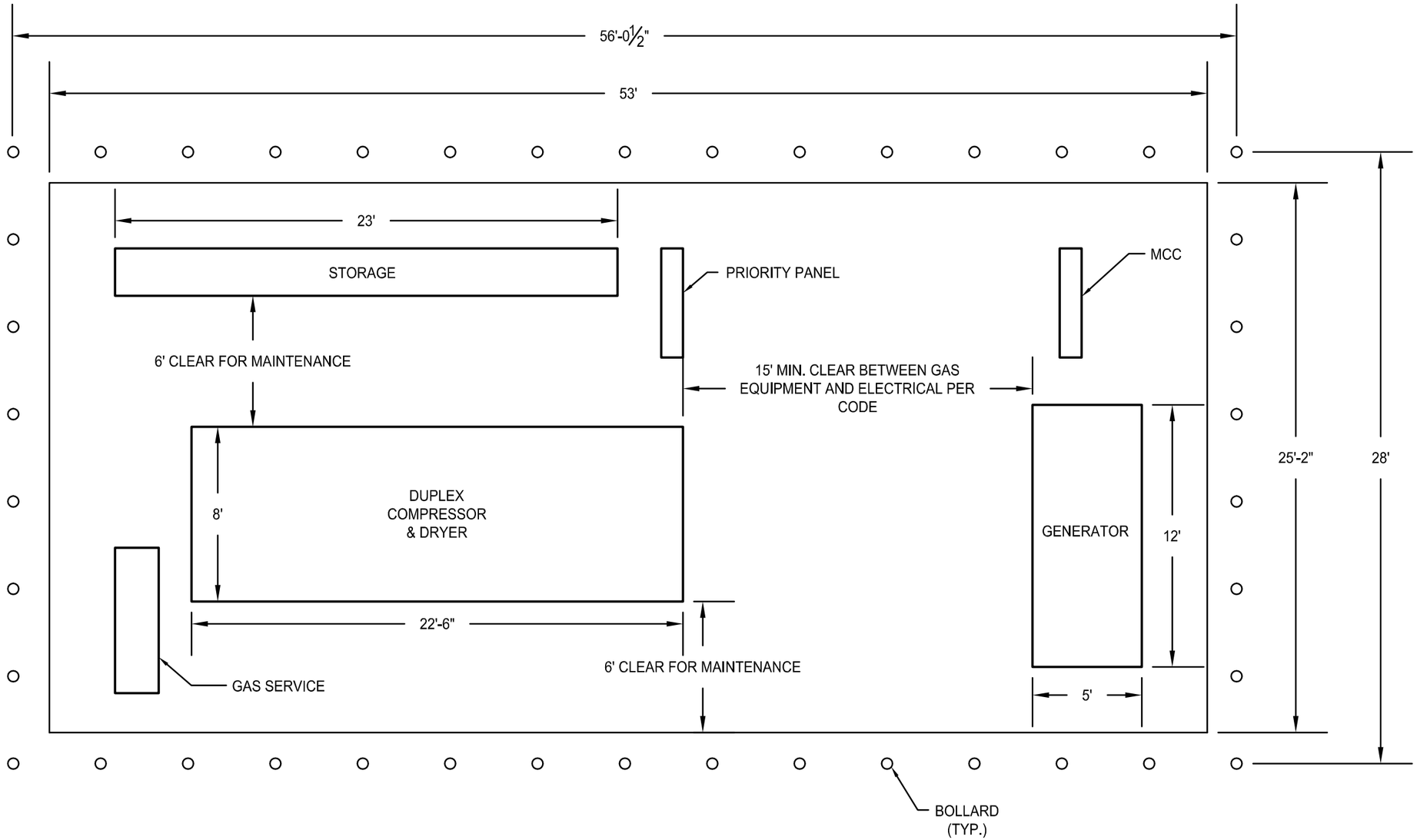
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MAT.& LAB.	ESTIMATED AMOUNT
	Bus Storage - Optional Methane Detection				
	Methane Detectors, conduit, wire, programming	14,078	sf	$ 4.40	$ 61,943
			Sub Total		$ 61,943
	Optional Methane Detection for Bus Storage Areas			**Project Sub Total:**	$ 61,943
25.0%	Alaska Escalation				$ 15,486
20.0%	Construction Contingency				$ 12,389
0.0%	Design				$ -
5.0%	Genaral Contractor Fee				$ 3,097
10.0%	General Conditions				$ 6,194
				ADDITIONAL PROJECT CHARGES	$ 37,166
	Fairbanks Operations and Maintenance Facility - Storage Detection			**TOTAL**	**$ 99,109**

APPENDIX A-5

OPINION OF PROBABLE COST WORKSHEET

Project Title:	DA Fairbanks AK Transit Garage	Project No.:	383901
Estimate:	CNG FUELING STATION	Revision Date:	08/15/2018
Location:	Fairbanks, AK	Orig. Date:	05/31/2018
Description:	On Site CNG Station	Estimated by:	CBC, RB1, SRN
File Name:	CNG Feasibility Study Estimates.xlsx	Checked by:	JTW
		Approved by:	SRN

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MAT.& LAB.	ESTIMATED AMOUNT
	CNG Compressor Compound				
	Natural Gas Service to Compound	1	ea	$ 5,000	$ 5,000
	Duplex 230 SCFM, 100HP NG100 Package	1	ea	$ 400,000	$ 400,000
	Compressor Site Connection Materials	2	ea	$ 1,675	$ 3,350
	Remote Duplex 100 HP Soft Starter Assembly	1	ea	$ 25,000	$ 25,000
	Communication Panel	1	ea	$ 5,850	$ 5,850
	Single Tower Manual Regen Dryer	1	ea	$ 57,500	$ 57,500
	1/2" Priority Panel	1	ea	$ 26,500	$ 26,500
	3 Pack 23' Long ASME storage	1	ea	$ 93,500	$ 93,500
	Dispenser Combination Fleet/High Flow Sequenced	2	ea	$ 59,000	$ 118,000
	Freight From WI - Per Truck	1	ea	$ 19,900	$ 19,900
	Priority panel temperature compensation	1	ea	$ 10,000	$ 10,000
	Bollards - 6" sch 40 galv. Conc. Filled, plastic sleeve	42	ea	$ 800	$ 33,600
	Compound Installation	1	ls	$ 250,000	$ 250,000
	Compound - Contrete Pad and Foundations Allowances	1	ea	$ 75,000	$ 75,000
			Sub Total		$ 1,048,200
	Fueling Systems Electrical				
	Generator (180kW, Natural Gas, Transfer Switch & Control Equi	1	ls	$ 121,650	$ 121,650
	Includes ATS, Weatherproof and Sound (Level 2) Enclosure				
	250A, 480VAC, 3-PH Panelboard (I-Line)	1	ea	$ 2,500	$ 2,500
	Feeder to CNG Compound Service Equipment	150	lf	$ 62.54	$ 9,381
	(3)#3/0AWG & #4GND in 2-1/2" RGS conduit from new building service				
	CNG Equipment Connections	4	ea	$ 8,100	$ 32,400
	Includes Equipment Wiring & Final Connections (90ft run for each)				
	Grounding Loop (Around Compound)	200	lf	$ 3.50	$ 700
	Control Wiring (MCC to each equipment)	4,200	lf	$ 0.77	$ 3,213
	Assume (10) conductors for each equipment in the compound				
	ESD Loop Wiring	150	lf	$ 11.88	$ 1,782
	Fire Alarm System Detection (Flame Detectors)	1	ls	$ 15,000	$ 15,000
			Sub Total		$ 186,626
			Project Sub Total		$ 1,234,826
25.0%	Alaska Escalation				$ 308,707
20.0%	Construction Contingency				$ 246,965
	Design Allowance				$ 200,000
5.0%	Genaral Contractor Fee				$ 61,741
10.0%	General Conditions				$ 123,483
				ADDITIONAL PROJECT CHARGES	$ 940,896
				CNG FUELING STATION TOTAL	**$ 2,175,722**



1 PRELIMINARY CNG COMPOUND LAYOUT
SCALE: NOT TO SCALE

wendel
www.wendelcompanies.com

CNG FEASIBILITY STUDY
FAIRBANKS, AK

PRELIMINARY CNG COMPOUND LAYOUT

Proj. No. 383901
Date 05/31/2018
Ref. Dwg.
No. M1

FNSB Transit - 20 Year Projected Natural Gas Demand

Fiscal Year	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29
Annual MCF	5,404	9,636	13,511	13,511	13,868	14,225	18,814	21,159	21,159	21,159
Monthly MCF	450	803	1,126	1,126	1,156	1,185	1,568	1,763	1,763	1,763
Maximum Annual CF Demand Potential	5,404,237	9,636,083	13,510,593	13,510,593	13,867,929	14,225,265	18,814,448	21,159,230	21,159,230	21,159,230
Total MCF Demand Potential To Date	5,404	15,040	28,551	42,062	55,929	70,155	88,969	110,128	131,288	152,447
MACS Fleet Cumulative CF Demand Projected	4,689,565	8,206,739	11,723,913	11,723,913	11,723,913	11,723,913	15,241,087	17,585,870	17,585,870	17,585,870
Van Tran Fleet Cumulative CF Demand Projected	714,672	1,429,344	1,786,680	1,786,680	2,144,016	2,501,352	3,573,361	3,573,361	3,573,361	3,573,361
MACS Fleet DGE @ 143.94 CF @ 8,145 Annually	4,689,565	3,517,174	3,517,174	-	-	-	3,517,174	2,344,783	-	-
Van Tran Fleet GGE @ 126.67 CF @ 2,821 Annually	714,672	714,672	357,336	-	357,336	357,336	1,072,008	-	-	-
Recommended CNG Fleet Replacement Schedule	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**	**FY27**	**FY28**	**FY29**
35' Low floor CNG buses	4	3	3	-	-	-	3	2	-	-
25' Cutaway CNG buses	2	2	1	-	1	1	3	-	-	-

Fiscal Year	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39
Annual MCF	21,159	21,159	21,159	21,159	21,159	21,159	21,159	21,159	21,159	21,159
Monthly MCF	1,763	1,763	1,763	1,763	1,763	1,763	1,763	1,763	1,763	1,763
Maximum Annual CF Demand Potential	21,159,230	21,159,230	21,159,230	21,159,230	21,159,230	21,159,230	21,159,230	21,159,230	21,159,230	21,159,230
Total MCF Demand Potential To Date	173,606	194,765	215,925	237,084	258,243	279,402	300,561	321,721	342,880	364,039
MACS Fleet Cumulative CF Demand Projected	17,585,870	17,585,870	17,585,870	17,585,870	17,585,870	17,585,870	17,585,870	17,585,870	17,585,870	17,585,870
Van Tran Fleet Cumulative CF Demand Projected	3,573,361 -	3,573,361	3,573,361	3,573,361	3,573,361	3,573,361	3,573,361	3,573,361	3,573,361	3,573,361
MACS Fleet DGE @ 143.94 CF @ 8,145 Annually	-	-	-	-	-	-	-	-	-	-
Van Tran Fleet GGE @ 126.67 CF @ 2,821 Annually	-	-	-	-	-	-	-	-	-	-
Recommended CNG Fleet Replacement Schedule	**FY29**	**FY30**	**FY31**	**FY32**	**FY33**	**FY34**	**FY35**	**FY36**	**FY37**	**FY38**
35' Low floor CNG buses	-	-	-	-	-	-	-	-	-	-
25' Cutaway CNG buses	-	-	-	-	-	-	-	-	-	-

FNSB TRANSIT FLEET CNG BUS REPLACEMENT EMISSION REDUCTIONS

DIESEL TRANSIT BUSES

Replacement		Unit			Year	BAU "Extended Life" Emissions (tons)				Replacement Life Cycle Emissions (tons)				Net Emission Reductions (tons)			
Cycle	Unit	Replaced	Year	LifeCycle	Replaced	PM2.5	VOC	CO	NOx	PM2.5	VOC	CO	NOx	PM2.5	VOC	CO	NOx
	144	71	2020	15	2035	0.0142	0.066	0.396	2.263	0.0012	0.045	2.668	0.725	0.013	0.021	-2.271	1.538
	145	72	2020	15	2035	0.0164	0.076	0.457	2.609	0.0014	0.051	3.076	0.836	0.015	0.024	-2.619	1.774
	146	73	2020	15	2035	0.0286	0.132	0.796	4.547	0.0024	0.090	5.359	1.456	0.026	0.042	-4.563	3.090
	147	74	2020	15	2035	0.0184	0.085	0.513	2.930	0.0016	0.058	3.453	0.938	0.017	0.027	-2.940	1.991
	148	710	2021	15	2036	0.0142	0.066	0.400	2.262	0.0012	0.045	2.666	0.724	0.013	0.021	-2.266	1.537
	149	75	2021	15	2036	0.0175	0.081	0.493	2.787	0.0015	0.055	3.285	0.893	0.016	0.026	-2.792	1.894
	150	76	2021	15	2036	0.0170	0.079	0.478	2.703	0.0015	0.053	3.187	0.866	0.016	0.025	-2.709	1.837
First	151	77	2022	15	2037	0.0159	0.074	0.451	2.526	0.0014	0.050	2.977	0.809	0.015	0.024	-2.526	1.717
	152	78	2022	15	2037	0.0141	0.066	0.400	2.241	0.0012	0.044	2.642	0.718	0.013	0.021	-2.242	1.523
	153	79	2022	15	2037	0.0150	0.070	0.427	2.392	0.0013	0.047	2.819	0.766	0.014	0.023	-2.392	1.626
	154	141	2026	15	2041	0.0180	0.072	0.384	1.087	0.0019	0.068	4.071	1.106	0.016	0.004	-3.686	-0.019
	155	142	2026	15	2041	0.0172	0.069	0.366	1.036	0.0018	0.065	3.879	1.054	0.015	0.004	-3.513	-0.018
	156	143	2026	15	2041	0.0189	0.076	0.403	1.140	0.0019	0.071	4.268	1.160	0.017	0.005	-3.865	-0.020
	157	Anch1	2027	15	2042	0.0035	0.014	0.077	0.212	0.0004	0.013	0.790	0.215	0.003	0.001	-0.713	-0.002
	158	Anch2	2027	15	2042	0.0143	0.059	0.311	0.860	0.0015	0.054	3.204	0.871	0.013	0.005	-2.893	-0.010
	159	144	2035	15	2050	0.0022	0.059	3.427	0.776	0.0012	0.045	2.668	0.725	0.001	0.014	0.758	0.051
	160	145	2035	15	2050	0.0025	0.068	3.951	0.895	0.0014	0.051	3.076	0.836	0.001	0.016	0.874	0.059
	161	146	2035	15	2050	0.0043	0.118	6.884	1.559	0.0024	0.090	5.360	1.456	0.002	0.029	1.524	0.102
	162	147	2035	15	2050	0.0028	0.076	4.436	1.004	0.0016	0.058	3.454	0.938	0.001	0.019	0.982	0.066
	163	148	2036	15	2051	0.0022	0.059	3.425	0.775	0.0012	0.045	2.667	0.724	0.001	0.014	0.758	0.051
	164	149	2036	15	2051	0.0027	0.073	4.219	0.955	0.0015	0.055	3.285	0.893	0.001	0.018	0.934	0.063
	165	150	2036	15	2051	0.0026	0.070	4.093	0.927	0.0015	0.053	3.187	0.866	0.001	0.017	0.906	0.061
Second	166	151	2037	15	2052	0.0024	0.066	3.824	0.866	0.0012	0.045	2.723	0.751	0.001	0.020	1.101	0.115
	167	152	2037	15	2052	0.0021	0.058	3.394	0.768	0.0011	0.040	2.417	0.667	0.001	0.018	0.977	0.102
	168	153	2037	15	2052	0.0023	0.062	3.621	0.820	0.0012	0.043	2.579	0.711	0.001	0.019	1.043	0.109
	169	154	2041	15	2056	0.0033	0.090	5.229	1.184	0.0010	0.038	2.334	0.711	0.002	0.052	2.895	0.472
	170	155	2041	15	2056	0.0031	0.086	4.982	1.128	0.0010	0.036	2.224	0.678	0.002	0.049	2.758	0.450
	171	156	2041	15	2056	0.0034	0.094	5.483	1.241	0.0011	0.040	2.447	0.746	0.002	0.054	3.035	0.495
	172	157	2042	15	2057	0.0006	0.017	1.014	0.230	0.0002	0.006	0.385	0.123	0.000	0.011	0.629	0.107
	173	158	2042	15	2057	0.0026	0.071	4.115	0.932	0.0007	0.025	1.564	0.498	0.002	0.045	2.551	0.434
DIESEL TOTALS						**0.2822**	**2.152**	**68.448**	**45.656**	**0.0403**	**1.481**	**88.714**	**24.460**	**0.242**	**0.672**	**-20.266**	**21.196**

GASOLINE VAN TRAN BUSES

Replacement		Unit			Year	BAU "Extended Life" Emissions (tons)				Replacement Life Cycle Emissions (tons)				Net Emission Reductions (tons)			
Cycle	Unit	Replaced	Year	LifeCycle	Replaced	PM2.5	VOC	CO	NOx	PM2.5	VOC	CO	NOx	PM2.5	VOC	CO	NOx
	2019-1	T144-13	2019	7	2026	0.0420	0.461	9.502	1.537	0.0005	0.016	1.030	0.378	0.0415	0.445	8.472	1.159
	2019-2	VT143-17	2019	7	2026	0.0071	0.195	2.733	0.192	0.0005	0.016	1.030	0.378	0.0066	0.179	1.703	-0.186
	2019-3	VT142-10	2019	7	2026	0.0070	0.194	2.720	0.192	0.0005	0.016	1.030	0.378	0.0065	0.178	1.690	-0.186
	2020-1	VT2-11	2020	7	2027	0.0070	0.194	2.720	0.192	0.0005	0.016	1.030	0.378	0.0065	0.178	1.690	-0.186
First	2020-2	VT3-11	2020	7	2027	0.0070	0.194	2.720	0.192	0.0005	0.016	1.030	0.378	0.0065	0.178	1.690	-0.186
	2021-1	VT4-11	2021	7	2028	0.0070	0.194	2.720	0.192	0.0005	0.016	1.030	0.378	0.0065	0.178	1.690	-0.186
	2021-2	VT5-11	2021	7	2028	0.0070	0.194	2.720	0.192	0.0005	0.016	1.030	0.378	0.0065	0.178	1.690	-0.186
	2022-1	VT6-11	2022	7	2029	0.0070	0.194	2.720	0.192	0.0005	0.016	1.030	0.378	0.0065	0.178	1.690	-0.186
	2024-1	VT7-17	2024	7	2031	0.0069	0.182	2.690	0.191	0.0005	0.016	1.031	0.378	0.0064	0.166	1.659	-0.187
	2025-1	T15-17	2025	7	2032	0.0069	0.182	2.690	0.191	0.0005	0.016	1.031	0.378	0.0064	0.166	1.659	-0.187
	2026-1	2019-1	2026	7	2033	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2026-2	2019-2	2026	7	2033	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2026-3	2019-3	2026	7	2033	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2027-1	2020-1	2027	7	2034	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
Second	2027-1	2020-2	2027	7	2034	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2028-1	2021-1	2028	7	2035	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2028-2	2021-2	2028	7	2035	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2029-1	2022-1	2029	7	2036	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2031-1	2024-1	2031	7	2038	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2032-1	2025-1	2032	7	2039	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2033-1	2026-1	2033	7	2040	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2033-2	2026-2	2033	7	2040	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2033-3	2026-3	2033	7	2040	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2034-1	2027-1	2034	7	2041	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
Third	2034-2	2027-1	2034	7	2041	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2035-1	2028-1	2035	7	2042	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2035-2	2028-2	2035	7	2042	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2036-1	2029-1	2036	7	2043	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	2038-1	2031-1	2038	7	2045	0.0007	0.033	1.926	0.440	0.0005	0.016	1.031	0.378	0.0002	0.017	0.895	0.062
	VT9-17	VT9-17	2017	5	2022	0.0061	0.155	1.651	0.160	0.0031	0.110	0.995	0.114	0.0030	0.045	0.656	0.046
GASOLINE TOTALS						**0.1242**	**2.970**	**72.183**	**11.773**	**0.0176**	**0.577**	**30.884**	**11.067**	**0.107**	**2.394**	**41.299**	**0.706**

ENTIRE TRANSIT FLEET TOTALS						**0.4063**	**5.123**	**140.631**	**57.429**	**0.0579**	**2.057**	**119.598**	**35.527**	**0.348**	**3.065**	**21.033**	**21.902**

ADA	Americans with Disabilities Act
AEO	Annual Energy Outlook
ASME	American Society of Mechanical Engineers
CF	Cubic Feet
CFM	Cubic Feet Per Minute
CH_4	Methane
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DGE	Diesel Gallon Equivalent
DPF	Diesel Particulate Filter
DEF	Diesel Exhaust Fluid
DTH	Dekatherm of Natural Gas
EPA	Environmental Protection Agency
FNSB	Fairbanks North Star Borough
F	Fahrenheit
FNG	Fairbanks Natural Gas
FTA	Federal Transit Administration
GGE	Gasoline Gallon Equivalent
GHGE	Greenhouse Gas Emissions
GPM	Gallons Per Minute
GVEA	Golden Valley Electric Association
G/BHP-HR	Grams Per Brake Horsepower Hour
HP	Horsepower
IFC	International Fire Code
IGU	Interior Gas Utility
IMC	International Mechanical Code
kW	Kilowatt
LNG	Liquefied Natural Gas
MACS	Metropolitan Area Commuter System
MCF	1000 Cubic Feet of Natural Gas
MMBtu	Million British Thermal Units
NEC	National Electrical Code
NFPA	National Fire Protection Association
NG	Natural Gas
NGV	Natural Gas Vehicle
NGVi	Natural Gas Vehicle Institute
NO_2	Nitrogen Dioxide
NOx	Oxides of Nitrogen
NPV	Net Present Value
NZ	Near Zero
PSI	Pounds per Square Inch
QVM	Qualified Vehicle Modifier
SCF	Standard Cubic F
SCFM	Standard Cubic Feet Minute
SCR	Selective Catalytic Reduction
SF	Square Feet
U.S. EIA	US Energy Information Administration
VEFF	Vehicle Equipment Fleet Fund

ARCHITECTURE
ENGINEERING
PLANNING
ENERGY EFFICIENCY
CONSTRUCTION MANAGEMENT

401 2nd Avenue North
Suite 206
Minneapolis, MN 55401
612-332-1401

Minnesota
New York
Virginia
Georgia
Arizona
Wisconsin
Connecticut
West Virginia
Washington, DC

By:	Bryce J. Ward, Mayor
Introduced:	01/24/2019
Referred to the Committee of the Whole:	01/24/2019
Advanced:	01/24/2019
Adopted:	02/14/2019

FAIRBANKS NORTH STAR BOROUGH

RESOLUTION NO. 2019–03

A RESOLUTION SUPPORTING CONVERSION FROM DIESEL AND GASOLINE TO COMPRESSED NATURAL GAS (CNG) VEHICLES FOR ALL TRANSIT REVENUE SERVICE VEHICLES WITHIN THE FAIRBANKS NORTH STAR BOROUGH TRANSPORTATION DEPARTMENT

WHEREAS, The CNG feasibility study dated September 6, 2018 is an integral component and requirement of the Federal Transit Administration Bus and Bus Facility Transit Garage Expansion Grant which was appropriated by the FNSB assembly on January 12, 2017; and

WHEREAS, The Transit Garage Expansion Project will include all necessary systems and structure to allow CNG powered vehicles to be stored and maintained within the new facility. The existing Transit Maintenance Center does not contain these provisions; and

WHEREAS, Once fleet conversion is complete, it is estimated that diesel and gasoline fuel consumption will be reduced by 129,315 gallons each year and will instead require 21,159,000 cubic feet of natural gas annually; and

WHEREAS, Converting the transit fleet to CNG provides air quality benefits by reducing particulate matter (PM2.5), volatile organic compounds (VOC), carbon monoxide (CO), nitrogen oxide (NOx) and carbon dioxide (CO2); and

WHEREAS, Committing to a CNG conversion plan could result in additional air quality benefits claimed within the State Implementation Plan for PM2.5 reductions; and

WHEREAS, Initial purchase cost of CNG powered vehicles are higher than those which are powered by liquid fuels. Savings in operational costs over the life of each vehicle are projected to offset the higher initial expense of CNG powered vehicles; and

Paratransit

By: Karl Kassel, Mayor
Introduced: 04/26/2018
Advanced: 04/26/2018
Adopted: 06/14/2018

FAIRBANKS NORTH STAR BOROUGH

ORDINANCE NO. 2017-20-2D

AN ORDINANCE AMENDING THE FY 2017-18 BUDGET BY APPROPRIATING $260,251 IN FEDERAL GRANT FUNDS AND $25,834 IN STATE MATCHING FUNDS TO THE TRANSIT ENTERPRISE PROJECTS FUND TO ACQUIRE FOUR NEW PARATRANSIT VANS

WHEREAS, $360,000 of Federal Transit Administration (FTA) funding and $35,735 of State matching funds were appropriated by the Fairbanks North Star Borough (Borough) Assembly in Ordinance No. 2012-20-2F and awarded to the Borough under FTA Grant #AK-95-X012 entitled "12 Congestion Mitigation Air Quality (CMAQ) Van Pool/Ride Share Option" and under Alaska Department of Transportation and Public Facilities (DOT&PF) Agreement #62446 "Van Pool/Ride Share Options Coordinator Project" respectively; and

WHEREAS, The Van Pool/Ride Share Program was unsuccessful and the Borough will lapse federal funds of $260,251, and state matching funds of $25,834 lapsed on February 22, 2018; and

WHEREAS, Under Public Law 111-5 and 49 U.S.C. §5307, the FTA makes formula grants available to urbanized areas (cities over 50,000 population) for capital and operating assistance for equipment and facilities owned by operators of public transportation systems; and

WHEREAS, The Americans with Disabilities Act of 1990 (ADA) requires all communities with a fixed bus route system to provide comparable paratransit service for those who cannot use the fixed route service because of their disabilities; and

WHEREAS, The Borough paratransit fleet must replace four vans that have met or exceeded their useful life according to FTA guidelines; and

WHEREAS, The CMAQ Project Evaluation Board approved the transfer of funds from the Van Pool/Ride Share Project to the purchase of four new paratransit vans; and

WHEREAS, The Fairbanks Metropolitan Area Transportation System (FMATS) Policy Board approved the transfer of funds from the Van Pool/Ride Share Project to the purchase of four new paratransit vans.

NOW, THEREFORE, BE IT ORDAINED by the Assembly of the Fairbanks North Star Borough:

Section 1. Classification. This ordinance is not of a general and permanent nature and shall not be codified.

Section 2. Lapse of Federal Grant Funds. The federal funds for the Van Pool/Ride Share Program, appropriated in Ordinance No. 2012-20-2F, are lapsed.

Section 3. Acceptance of Federal and State Matching Funds. The Borough formally accepts the award of $260,251 in FTA 49 U.S.C. §5307 grant funding and $25,834 in State DOT&PF matching funds.

Section 4. Transit Enterprise Projects Fund Grant Appropriation. The FY 2017-18 budget is hereby amended by appropriating $286,085 to the Transit Enterprise Projects Fund budgetary guideline entitled "FTA §5307 Paratransit Van Purchase" and by increasing estimated revenue from federal grants by $260,251 and estimated revenue from State grants by $25,834.

Section 5. Administrative Fee Waiver. Indirect fees are waived in accordance with Borough Ordinance No. 2011-42, which waived indirect on all existing and future FTA grants and associated matching funds.

Section 6. Eligible Expenditure Period. Expenditures subsequent to the effective date of the executed grant agreement are eligible for reimbursement.

Section 7. Provision for Appropriation Estimates. The appropriation of grant funds is for an estimated amount. The actual amount will be appropriated. Any material difference, as determined by the Chief Financial Officer, will be communicated to the Assembly.

Section 8. Contingency. This appropriation is contingent upon receipt of a signed grant agreements with FTA and the DOT&PF.

Section 9. Effective Date. This ordinance shall be effective at 5:00 p.m. on the first Borough business day following its adoption.

PASSED AND APPROVED THIS 14TH DAY OF JUNE, 2018.

Kathryn Dodge
Presiding Officer

FAIRBANKS NORTH STAR BOROUGH SEAL JAN. 1, 1964 STATE OF ALASKA

ATTEST:

April Trickey, CMC
Borough Clerk

Yeses: Gray, Tacke, Cooper, Roberts, Lojewski, Quist, Major, Lawrence, Dodge
Noes: None

FAIRBANKS NORTH STAR BOROUGH
FISCAL NOTE

I. Request

Ordinance No: 2017-20- 2D Date Introduced: 4/26/18

Abbreviated Title: Appropriate $286,085 to Acquire Four New Paratransit Vans

II. Financial Detail

Department/Division Affected: Transportation/Transit

EXPENDITURE	Transit Enterprise Projects Fund		Total
	FY 17/18	FY 17/18	FY 17/18
Personnel Services			
Contractual Services			
Contribution to Transit Enterprise Projects Fund			
Contribution to Unrestricted Net Assets			
Other - Awaiting Budget	286,085		
Total	286,085		

SOURCE OF FUNDING			
Federal Funds	260,251		
State Funds	25,834		
Contribution from Transit Enterprise Operating Fund			
Total	286,085		

Specify Funding Sources: Federal Transit Administration and State of Alaska, DOT & PF

OTHER FUNDING (PREVIOUSLY APPROPRIATED)

III. Project Purpose:

To replace four paratransit vans that have met their useful service life as defined by Federal Transportation Administration

IV. Analysis of Future Liabilities and Funding Sources:

Ongoing repairs and maintenance of paratransit vans

V. Fund Certification: I certify that funding sources are available as detailed in II above.

Debra L. R. Brady 4/3/18

Debra L. R. Brady
Chief Financial Officer
Date

KT MG	FA	SA	
	GLA	GA	85
BO	CA	SpA	
	C	TBM	

WHEREAS, Committing to a structured conversion schedule further emphasizes the borough's devotion to encourage and assist borough residents with transitions to natural gas and improved air quality.

NOW THEREFORE BE IT RESOLVED that the Assembly of the Fairbanks North Star Borough recognizes the value and importance to air quality and supports a structured CNG conversion schedule for revenue service vehicles within the transportation department.

PASSED AND APPROVED THIS 14TH DAY OF FEBRUARY, 2019.

Matt Cooper
Presiding Officer

ATTEST:

April Trickey, CMC, Borough Clerk
by Adella Benn, CMC, Deputy Borough Clerk

Yeses: Williams, Sanford, Gray, Lyke, Major, Cooper
Noes: Lojewski, Tacke, Quist

By: Karl Kassel, Mayor
Introduced: 07/27/2017
Advanced: 07/27/2017
Adopted: 08/10/2017

FAIRBANKS NORTH STAR BOROUGH

ORDINANCE NO. 2017-20-1E

AN ORDINANCE AMENDING THE FY 2017-18 BUDGET BY APPROPRIATING $1,742,800 IN FEDERAL AND STATE GRANT FUNDS, AND $97,100 FROM TRANSIT ENTERPRISE FUND UNRESTRICED NET POSITION TO ACQUIRE FOUR NEW TRANSIT BUSES

WHEREAS, The State of Alaska Department of Transportation and Public Facilities (DOT&PF) has received Federal Highway Administration (FHWA), Congestion Mitigation Air Quality (CMAQ) funding and that funding is expected to be transferred to the Federal Transit Administration (FTA) under 49 U.S.C Section 5307 as a formula grant for capital and operating assistance for equipment and facilities owned by operators of public transportation systems; and

WHEREAS, The DOT&PF has made available Community Transportation Program (CTP) combined federal and state funding and that funding is expected to be transferred to the FTA under 49 U.S.C Section 5307 as a formula grant for capital and operating assistance for equipment and facilities owned by operators of public transportation systems; and

WHEREAS, The federal fiscal years 2016-2019 State of Alaska Transportation Improvement Program Amendment 2, approved by the FTA on April 20, 2017, identified funding for bus acquisitions; and

WHEREAS, Two 1994 Fairbanks North Star Borough (Borough) Transit buses have far exceeded their useful life per FTA-required useful service lives and two 2007 Borough Transit buses have also exceeded their useful life according to FTA-required useful service lives of 10 years, or 350,000 miles; and

WHEREAS, The two 1994 Borough Transit buses' wheelchair lifts are unreliable and require constant repair; and

WHEREAS, An estimated $978,300 in CTP funds are expected to be transferred to FTA and are expected to become available for this project; and

WHEREAS, An estimated $695,500 in FHWA CMAQ funds are expected to be transferred to FTA and are expected to become available for this project; and

WHEREAS, An estimated $69,000 in DOT&PF state match funds are expected to become available; and

WHEREAS, An estimated $97,100 will be provided by Transit Enterprise Fund Unrestricted Net Position as local match.

NOW, THEREFORE, BE IT ORDAINED by the Assembly of the Fairbanks North Star Borough:

Section 1. Classification. This ordinance is not of a general and permanent nature and shall not be codified.

Section 2. Acceptance of CTP Funding. The Borough formally accepts the award of an estimated $978,300 in CTP funding.

Section 3. Acceptance of FHWA - CMAQ Funding. The Borough formally accepts the award of an estimated $695,500 in CMAQ funding.

Section 4. Acceptance of DOT&PF Match Funding. The Borough formally accepts the award of an estimated $69,000 in DOT&PF match funding.

Section 5. Transit Enterprise Operating Fund Appropriation. Notwithstanding the Reserve Policies section IV.B. of the Borough's fiscal policies as stated in Attachment B of the current year adopted budget Ordinance No. 2017-20, the FY 2017-18 budget is hereby amended by appropriating $97,100 to the Transit Enterprise Operating Fund budgetary guideline entitled "Contribution to Transit Enterprise Projects Fund," and by increasing Contribution from Transit Enterprise Unrestricted Net Position by a like amount.

Section 6. Transit Enterprise Project Fund Appropriation. The FY 2017-18 budget is hereby amended by appropriating $1,839,900 to the Transit Enterprise Project Fund budgetary guideline entitled "Transit Bus Acquisitions" and by increasing estimated revenue from federal and state grants by $1,742,800, and by $97,100 from Transit Enterprise Operating Fund.

Section 7. Provision for Appropriation Estimates. These appropriations are estimated amounts. The actual amounts will be appropriated contingent, and based upon (a) signed grant agreement(s). Any material differences, as determined by the Chief Financial Officer, will be communicated to the Assembly.

Section 8. Provision for Accounting. These appropriations are to be recorded and accounted for on the Borough's books using the most suitable methods, accounts, funds, and budgetary guidelines as determined by the Chief Financial Officer.

Section 9. Eligible Expenditure Period. Expenditures subsequent to the effective date(s) of the executed grant agreement(s) are eligible for reimbursement.

Section 10. Administrative Fee Waiver. Indirect fees are waived in accordance with Borough Ordinance No. 2011-42, which waived indirect on all existing and future FTA grants and associated matching funds.

Section 11. Contingency. This appropriation is contingent upon receipt of (a) signed grant agreement(s).

Section 12. Lapse of Funds. Upon the completion or abandonment of the project, any unencumbered, unexpended local funds will lapse to the Transit Enterprise Unrestricted Net Position.

Section 13. Effective Date. This ordinance shall be effective at 5:00 p.m. on the first Borough business day following its adoption.

PASSED AND APPROVED THIS 10th DAY OF AUGUST, 2017.

Kathryn Dodge
Presiding Officer

FAIRBANKS NORTH STAR BOROUGH SEAL JAN. 1, 1964 STATE OF ALASKA

ATTEST:

Nanci Ashford-Bingham, MMC
Borough Clerk

Yeses: Tacke, Cooper, Quist, Roberts, Sattley, Gray, Davies, Lawrence, Dodge
Noes: None

Adopted November 19, 2019

FAIRBANKS NORTH STAR BOROUGH
FISCAL NOTE

I. Request

Ordinance No: 2017-20- 1E Date Introduced: July 27, 2017

Abbreviated Title: $1,742,800 in Federal and State Grant Funds and $97,100 from the Transit Enterprise Fund to acquire four new transit buses

II. Financial Detail

Department/Division Affected: Transportation/Transit

EXPENDITURE	Transit Enterprise Operating Fund	Transit Enterprise Projects Fund	Total
	FY 17/18	FY 17/18	FY 17/18
Contractual Services			
Capital Outlay			
Contribution to Transit Enterprise Projects Fund	97,100		
Other - Awaiting Budget		1,839,900	
Total	97,100	1,839,900	

SOURCE OF FUNDING			
General Fund			
Federal and State Grants		1,742,800	
Contribution From Unrestricted Net Position	97,100		
Contribution From Transit Enterprise Operating Fund		97,100	
Total	97,100	1,839,900	

Specify Funding Sources: Federal Highway Administration (FHWA), Congestion Mitigation Air Quality (CMAQ) Program; State of Alaska, Department of Transportation & Public Facilities (DOT&PF), Transit Enterprise Fund Unrestricted Net Position

III. Project Purpose:

To acquire four new transit buses

IV. Analysis of Future Liabilities and Funding Sources:

Ongoing maintenance and operating costs

V. Fund Certification: I certify that funding sources are available as detailed in II above.

Debra L. R. Brady 7/13/17
Debra L. R. Brady, Chief Financial Officer — Date

FA	SA
GLA	GA
CA	SpA
C	TBM