ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Amendments to:

State Air Quality Control Plan

Vol. II: III.D.7.6

Emission Inventory Data

Public Notice Draft

September 10, 2020

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Jason W. Brune, Commissioner

Note: This document provides revised and/or new language proposed for inclusion in this section of the State Air Quality Control Plan addressing the Fairbanks North Star Borough $PM_{2.5}$ Serious nonattainment area. The revised and/or new proposed language is in bold and underlined format. Language proposed to be deleted or replaced is shown in strikeout format. These revisions are the only part of this section that are open for public review and comment in this update to the plan. To aid in the public comment process, the currently adopted sections of the air quality plan can be found and referenced at the following internet site: http://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-serious-sip/

7.6 EMISSION INVENTORY DATA

7.6.1. Introduction

7.6.1.1 Purpose of the Emission Inventory

Title I of the Clean Air Act Amendments of 1990 (CAA) contains provisions requiring development of emission inventories for designated areas that fail to meet the National Ambient Air Quality Standards (NAAQS). The emission inventory (subsequently referred to as the EI or simply "inventory") is a collection of emission estimates separately compiled for each potential source of air pollutants within the nonattainment area and surrounding regions and then integrated into a combined framework. Stated simply, the inventory is used to identify the key sources of emissions and contributions from all sources in the area and serves as a basis for determining how to best reduce pollutant emissions in order to reach or attain the NAAQS.

Relevant Regulatory Actions - A portion of the Fairbanks North Star Borough (FNSB) that includes the cities of Fairbanks and North Pole as well as surrounding areas was classified as a Moderate $PM_{2.5}$ nonattainment area in November 2009[1] for violation of the 24-hour average standard (35 $\mu g/m^3$) enacted in 2006. The State of Alaska was given until December 2014 to prepare and submit a State Implementation Plan (SIP) that included a strategy to attain the $PM_{2.5}$ NAAQS in the FNSB area. In compliance with EPA requirements, the Moderate Area SIP evaluated whether attainment could be demonstrated by December 31, 2015 or if not, explain why attainment by that date was impracticable. Emission inventories were prepared, control strategies were developed and evaluated, and air quality modeling was conducted under the Moderate SIP. This analysis led the State of Alaska to conclude that the level of emission reductions required to attain the $PM_{2.5}$ NAAQS could not be practicably achieved by that December 2015 attainment date. Thus, the Moderate SIP found that attainment of the 24-hour $PM_{2.5}$ standard by 2015 was impracticable (although possible by 2019).

As a result of the FNSB area's failure to attain the 24-hour $PM_{2.5}$ standard by 2015, EPA reclassified[2] the area (effective June 9, 2017) as a Serious $PM_{2.5}$ nonattainment area, for which attainment by 2019 must be evaluated and a more stringent analysis of control measures conducted and tracked within the inventory.

On July 29, 2016, EPA also promulgated[3] the $PM_{2.5}$ Implementation Rule (subsequently referred to as the PM Rule) which interprets the statutory requirements that apply to $PM_{2.5}$ NAAQS nonattainment areas under subparts 1 and 4 of the nonattainment provisions of the CAA. These requirements govern both attainment plans and nonattainment new source review (NNSR) permitting programs and specify planning requirements that include:

[1] Federal Register, Vol. 74, No. 218, November 13, 2009 (74 FR 58688).

[2] Federal Register, Vol. 82, No. 89, May 10, 2017 (82 FR 21711).

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

- **plan due dates, attainment dates and attainment date extension criteria;**
- **the process for determining control strategies, including Reasonably Available Control Measures/Reasonably Available Control Technology (RACM/RACT) for Moderate areas; and Best Available Control Measures/Best Available Control Technology (BACM/BACT) and Most Stringent Measures (MSM) for Serious areas;**
- **guidelines for attainment demonstrations for areas that can attain by the statutory attainment date, and "impracticability" demonstrations for areas that cannot practicably attain by the statutory attainment date;**
- **RFP and quantitative milestones for demonstrating RFP;**
- **contingency measures for areas that fail to meet RFP or fail to attain the NAAQS by the attainment date.**

~~As discussed in the following sub-section, a number of these PM Rule planning requirements affect the inventories required under the Serious SIP.~~

On September 8, 2017, EPA approved the FNSB $PM_{2.5}$ Moderate Area SIP (effective October 10, 2017) which was originally submitted by the State of Alaska in December 2014 (and included supplemental clarifying information). EPA found that the Moderate SIP met all statutory and regulatory requirements including those for base-year and projected emissions inventories as well as those associated with Reasonable Further Progress (RFP), Quantitative Milestone (QM) and Motor Vehicle Emission Budget (MVEB) requirements.

On December 13, 2019 DEC submitted the Fairbanks $PM_{2.5}$ Serious Area SIP to EPA. Its key finding was that attainment by the statutorily required date of December 31, 2019 was not possible. As clarified in the PM Rule and in accordance with CAA section 189(d), Fairbanks must submit a plan revision to EPA within 12 months of failing to attain by December 2019 which provides for annual reductions in $PM_{2.5}$ or precursor emissions within the area of not less than 5 percent of the amount of such emissions as reported in the most recent inventory prepared for Fairbanks.

For continuity and comprehensiveness, this section (III.D.7.6) contains separate discussions of emission inventory development and reporting requirements in fulfillment of both the previously submitted Serious Area SIP as well as the Amendment to the Serious SIP (2020 Amendment) that must be prepared and submitted to EPA by December 31, 2020. Sections 7.6.1 though 7.6.4 encompass the discussion of emission inventories in support of the Serious SIP. Section 7.6.5 is applicable to both the Serious and 2020 Amendment. Finally, Sections 7.6.6 through 7.6.8 contain separate discussions of emission inventories developed in support of the 2020 Amendment.

For the Serious SIP ~~On July 29, 2016, EPA also promulgated[4] the $PM_{2.5}$ Implementation Rule (subsequently referred to as the PM Rule) which interprets the statutory requirements that apply to $PM_{2.5}$ NAAQS nonattainment areas under subparts 1 and 4 of the nonattainment provisions of~~

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

~~the CAA. These requirements govern both attainment plans and nonattainment new source review (NNSR) permitting programs and specify planning requirements that include:~~

- ~~plan due dates, attainment dates and attainment date extension criteria;~~
- ~~the process for determining control strategies, including Reasonably Available Control Measures/Reasonably Available Control Technology (RACM/RACT) for Moderate areas; and Best Available Control Measures/Best Available Control Technology (BACM/BACT) and Most Stringent Measures (MSM) for Serious areas;~~
- ~~guidelines for attainment demonstrations for areas that can attain by the statutory attainment date, and "impracticability" demonstrations for areas that cannot practicably attain by the statutory attainment date;~~
- ~~RFP and quantitative milestones for demonstrating RFP;~~
- ~~contingency measures for areas that fail to meet RFP or fail to attain the NAAQS by the attainment date.~~

~~As discussed in the following sub-section, a number of these PM Rule planning requirements affect the inventories required under the Serious SIP.This~~ **this** report describes how emissions were first estimated for the 2013 base year and then projected forward to 2019 with technically and economically feasible controls implemented within that time to determine whether the area will reach attainment by 2019. This attainment analysis is based on atmospheric modeling that simulates the formation of ambient $PM_{2.5}$ given input emissions and meteorology as described in detail in the "Attainment Modeling" document. **For the 2020 Amendment, it then describes how a revised 2019 baseline inventory was prepared and how future inventories were developed to support attainment analysis and other emission reduction requirements in effect under the 2020 Amendment.**

Where applicable, **this report** ~~it~~ will also identify key revisions to the emission inventories prepared under the Moderate **and Serious SIPs** ~~SIP~~ based on additional collected data or updated methodologies.

The FNSB ~~Serious Area~~ SIP emission inventory is considered a Level II inventory, as classified under the Emission Inventory Improvement Program (EIIP).[5] It is a Level II inventory because it will provide supportive data for strategic decision making under the context of the SIP and is based on a combination of locally and regionally collected data.

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[5] "Introduction to the Emission Inventory Improvement Program, Volume 1," prepared for Emission Inventory Improvement Program Steering Committee, prepared by Eastern Research Group, Inc., July 1997.

7.6.6. 2020 Amendment Plan 2019 Base Year Inventory

The preceding sub-sections (7.6.2 through 7.6.5) discussed the development of the emission inventories for the Serious SIP. The remaining sub-sections (7.6.6 through 7.6.8) describe the methods and source used to develop the inventories required for the Fairbanks 2020 Amendment to the Serious SIP in accordance with the requirements of Section 189(d) of the CAA as enumerated in Section VII of the PM Rule.

The first element in inventory development for the amended plan consists of selection and preparation of a Base Year emission inventory in accordance with Section 172(c)(3) of the CAA and Section VII.B of the PM Rule preamble. Specifically, the Base Year should be one of the three years for which air quality data were used to determine that the area failed to attain the $PM_{2.5}$ NAAQS by the Serious Area attainment date. Fairbanks was required to attain the $PM_{2.5}$ NAAQS by December 31, 2019 and the three years of air quality data used to make the determination that it failed to attain were 2017 through 2019. In accordance with these requirements and as a logical "bridge" between the statutory attainment date of the Serious SIP and the 2020 Amendment Plan, under which emission reductions of 5% per year must be demonstrated, 2019 was selected as the Base Year for the 2020 Amendment Plan and subsequent emission inventory development.

Similar to the layout of the documentation for the Serious SIP 2013 Baseline inventory, the following sub-sections of Section 7.6.6 provide an overview of the source sectors of the inventory (7.6.6.1) followed by detailed discussions of each sector (7.6.6.2-7.6.6.6). Processing procedures to prepare modeling and planning inventories are described in sub-section 7.6.6.7. Finally, resulting 2019 Base Year emissions are presented and discussed in sub-section 7.6.6.8.

To aid the reader, rather than simply referencing corresponding sub-sections of Section 7.6.2 where the baseline inventory for the Serious SIP is documented and describing revisions to those methods in preparing the 2019 Base Year inventory for the 2020 Amendment Plan, this section was written to be largely self-contained. Although some of the text is repeated, this approach avoids requiring the reader to go back and forth between this section and Section 7.6.2.

7.6.6.1 Sector Overview

Overview – Considerable effort was invested in developing modeling and planning emission estimates for the 2020 Amendment Plan 2019 Base Year inventory. Because of strong variations in monthly, daily, and diurnal source activity and emission factors (largely driven by significant swings in ambient conditions between very cold winters and warm summers within the Alaskan interior), it was critically important to account for these effects in developing the 2019 Base Year modeling inventory for each of the 35 winter episode days.

For all inventory sectors, episodic modeling inventory 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 judged to be less significant or 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*,[6] AP-42 database.

Table 7.6-1 briefly summarizes the data sources and methods used to develop episodic modeling inventory emissions by source type. It also highlights those elements based on locally collected data. As shown by the shaded regions in Table 7.6-1, the majority of both episodic wintertime activity and emission factor data supporting the 2019 Base Year inventory was developed based on local data and test measurements.

The emission inventory for the 2019 Base Year will subsequently be referred to the as the 2019 Baseline inventory in that it will be used to address both planning and attainment modeling-related inventory requirements. For planning purposes, it represents a baseline of nonattainment area emissions for which 5% per year reductions must be demonstrated. In attainment modeling, it represents the emission inventory that is associated with ambient monitoring data used to establish the baseline design value in 2019 from which control measure-driven emission reductions in future years are used within the air quality model to forecast when attainment will occur.

It should be noted that the 2019 Baseline inventory under the 2020 Amendment to the Serious SIP is functionally equivalent to what was referred to as the 2019 Control inventory within the Serious SIP. Although the 2020 Amendment SIP 2019 Baseline inventory contains revised activity and emission estimates for certain source sectors as described later under "Revised Serious SIP Estimates," it also accounts for emission reductions from control measures adopted and implemented through December 31, 2018 as reflected in the Serious SIP 2019 Control inventory. Thus, it represents logical ending and starting points between the Serious and 2020 Amendment SIPs, respectively.

[6] Compilation of Air Pollutant Emission Factors," Fifth Edition and Supplements, AP-42, U.S. EPA, Research Triangle Park, NC. January 1995.

Table 7.6-1
Summary of Data/Methods Used in the 2020 Amendment SIP 2019 Base Year Inventory

Source Type/Category	Source Activity	Emission Factors
Point Sources	Episodic facility and stack-level fuel use and process throughput	Continuous emissions monitoring or facility/fuel-specific factors
Area (Nonpoint) Sources, Space Heating	Detailed wintertime FNSB nonattainment area residential heating device activity measurements and surveys	- Test measurements of common FNSB 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 - 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 FNSB 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 FNSB for other categories	- MOVES2014b model factors for non-road equipment - AEDT model factors for aircraft - EPA factors for locomotives

As evidenced by source classification structure used to highlight utilization of key local data sources, development of detailed episodic emission estimates to support the attainment modeling focused on three key source types:

1. ***Stationary Point Sources*** **– industrial facility emissions for "major" stationary sources as defined later in this sub-section developed from wintertime activity and fuel usage;**

2. ***Space Heating Area (Nonpoint) Sources*** **– residential and commercial heating of buildings with devices/fuels used under wintertime episodic ambient conditions; and**

3. ***On-Road Mobile Sources*** **– on-road vehicle emissions based on local activity and fleet characteristics with EPA-accepted adjustments to account for effects of wintertime**

vehicle/engine block heater "plug-in" use in Fairbanks using MOVES2014b (the latest version of MOVES).

As seen in emission summaries presented later in this sub-section, these three source types were the major contributors to both direct $PM_{2.5}$ emissions as well as emissions of potential precursor pollutants SO_2, NO_x, VOC, and NH_3 within both the nonattainment area as well as the broader Grid 3 modeling domain.

Following this overview, expanded summaries are presented that describe the approaches used to generate episodic emission estimates for each source types/category listed in Table 7.6-1 for the 2019 Baseline inventory. In addition to these methodology summaries, Appendix III.D.7.6 provides detailed descriptions of the data sources, issues considered, and step-by-step methods and workflow used to generate modeling inventory emissions at the Source Classification Code (SCC) level.

Following these summaries, a series of detail tabulations and plots of the 2019 Baseline inventory are presented.

Revised Serious SIP Estimates – The Serious SIP contained a 2013 Baseline inventory. This inventory was re-developed for the 2019 base year of the 2020 Amendment Plan based on new or revised activity estimates since the Serious SIP development for which key elements are summarized below.

- ***Point Sources* – 2008 activity and emissions data were updated to 2019 based on actual annual 2019 fuel use/process throughput by individual facility and emission unit collected by DEC in January-March 2020. (Point source emissions in the Serious SIP for 2019 had been projected from 2013 annual data based on population forecasts.)**

- ***Space Heating Area Sources* – Space heating energy usage estimates for the 2019 Baseline inventory were based on the same local data/models (2011-2015 Home Heating surveys and Home Heating Energy Model) used in the Serious SIP. However, the wood-oil cross price elasticity effects (shifting energy use between wood and oil as oil prices fluctuate) in the 2020 Amendment to the Serious SIP were updated based on actual rather than projected 2019 Fairbanks heating oil prices. (As discussed in detail later, this price difference was very small.) A more substantive revision to space heating emissions resulted from the use of more disaggregated estimates of emission reductions from the Borough's Wood Stove Change Out (WSCO) Program. Under the Serious SIP, historical WSCO reductions were estimated based on average household energy usage across all devices. For the 2020 Amendment to the Serious SIP, energy usage estimates for each household were developed by replacement device/fuel type to be consistent with a more granular methodology developed and used by the Borough to track and report quarterly Targeted Airshed Grant (TAG) data from the WSCO Program required by EPA under the administration of those grants. Finally, the PM emission factor**

for residential natural gas combustion from EPA's AP-42 database was updated based on more recent testing data collected by Brookhaven Labs.

- ***On-Road and Non-Road Mobile Sources* – Under the Serious SIP, on-road vehicle populations and age distributions had been based on 2014 DMV registration data. For the 2020 Amendment to the Serious SIP, a more recent 2018 DMV registration database was used to develop these MOVES vehicle emissions model inputs. Within the non-road mobile source sector, annual aircraft activity that was assumed to be constant by month within the Serious SIP was revised under the 2020 Amendment to the Serious SIP based on monthly data collected from the airfields in the nonattainment area that showed less aircraft activity during winter months than the rest of the year. (Total annual aircraft operations remain unchanged from the Serious SIP, only the monthly distributions were revised.)**

Data sources and methodologies specific to each source sector used to estimate 2019 Baseline emissions are presented in source sector-specific sub-sections that follow.

7.6.6.2 Stationary Point Sources

For the 2019 Baseline inventory, DEC queried facilities from its permits database to identify major and minor point source facilities within the modeling domain. DEC uses the definition of a major source under Title V of the Clean Air Act (as specified in 40 CFR §51.20) to define the "major source" thresholds for reporting annual emissions. These thresholds are the potential to emit (PTE) annual emissions of 100 tons for all relevant criteria air pollutants. Natural minor and synthetic minor facilities (between 5 and 99 TPY) reporting emissions under either New Source Review (NSR) or Prevention of Significant Deterioration (PSD) requirements were also included in the query to identify facilities down to the 70 TPY threshold required to classify stationary point sources under 2020 Amendments to the Serious Plan inventory requirements.

A total of 14 facilities were identified. Of these, DEC noted that three of the facilities—the Golden Valley Electric Association (GVEA) Healy Power Plant and the heating/power plants at Fort Greely (near Delta Junction) and Clear Air Force Base (near Anderson)—were excluded from development of episodic emissions. These facilities were excluded because of their remoteness relative to Fairbanks (all are between 55 and 78 miles away)[7] or the fact that they were located generally downwind of the nonattainment area under episodic air flow patterns (Healy Power Plant and Clear AFB). Three others were identified as minor/synthetic minor sources: (1) Fort Knox Mine (26 miles northeast of Fairbanks), (2) Usibelli Coal Preparation Plant (in Healy), and (3) CMI Asphalt Plant (in Fairbanks); these were excluded from treatment as individual stationary point sources because they either were located outside the nonattainment area (Fort Knox and Usibelli) or exhibited insignificant wintertime activity (CMI Asphalt Plant). These facilities

[7] Individual point source plume modeling conducted by DEC in support of the SIP using the CALPUFF model found that under the episodic meteorological conditions, emissions from facilities located outside the Fairbanks $PM_{2.5}$ nonattainment area exhibited negligible contributions to ambient $PM_{2.5}$ concentrations in the area.

excluded from the point source sector were treated as stationary non-point or area sources within the inventory.

The names and primary equipment and fuels of the eight remaining facilities for which episodic data were collected and developed are summarized in Table 7.6-2. One facility, Eielson Air Force Base, is located just outside the nonattainment area boundary on the southeast edge. All other facilities listed in Table 7.6-2 are located within the nonattainment area. The submitted data were then assembled and reviewed for completeness, consistency, and validity prior to integrating the episodic data into the SIP inventories. Given the differences in structure and content of the submitted episodic data, the data were individually reviewed for each facility before being assembled into a consistent inventory structure.

Table 7.6-2
Summary of SIP Modeling Inventory Point Source Facilities

Facility ID	Facility Name	Primary Equipment/Fuels
71	Flint Hills North Pole Refinery	11 crude & process heaters burning process gas/LPG (9 operated during episodes), plus 2 natural gas fired steam generators, gas flare
109	GVEA Zehnder (Illinois St) Power Plant	Two gas turbines burning distillate oil,[a] two diesel generators burning Jet A
110	GVEA North Pole Power Plant	Three gas turbines, two burning distillate oil,[a] one burning naphtha (plus an emergency generator and building heaters not used during episodes)
236	Fort Wainwright	Backup diesel boilers & generators (3 each) - none operated during episodes
264	Eielson Air Force Base	Over 70 combustion units – only six coal-fired main boilers operated during episodes
315	Aurora Energy Chena Power Plant	Four coal-fired boilers (1 large, 3 small), all exhausted through common stack
316	UAF Campus Power Plant	Two coal-fired, two oil-fired boilers (plus backup generators & incinerator not operated during episodes)
1121	Doyon Utilities (private Fort Wainwright units)	Six coal-fired boilers

[a] Prior to 2017, both the GVEA facilities burned Heavy Atmospheric Gas Oil (HAGO). HAGO is a crude distillate at the heavy end of typical refinery "cuts" with typical boiling points ranging from 610-800°F. GVEA seasonally used HAGO, a by-product from the adjacent Flint Hills Refinery until the refinery was shut down in 2014. (Existing HAGO supply at the GVEA facilities was exhausted by 2016.)

At a minimum, facilities provided SCC codes and hourly $PM_{2.5}$ and SO_2 emission rates by individual emission unit along with daily/hourly fuel usage or process throughput data and emission factors for the remaining criteria pollutants. For facilities that did not provide emissions for all criteria pollutants, NOx, NH_3 and VOC emissions were computed from

AP-42[15] based or facility source test emission factors (where fuel use data were explicitly provided) or from fuel-specific emission factor ratios.

For the 2019 Baseline inventory under the 2020 Amendment to the Serious SIP, DEC emailed each of the facilities within the nonattainment area requesting annual actual emissions by emission unit for each facility in calendar year 2019. These data were received in spreadsheet for from January-March 2020 and were integrated into a master spreadsheet and used to scale the day/hour specific 2008 episodic data provided by each facility from 2008 to 2019. This approach essentially simulates the levels of facilityspecific emissions from the 2008 modeling episodes relative to annual emissions, carried forward to 2019.[8]

Table 7.6-3 compares annual fuel use by facility between 2008, 2013 and 2019, including splits of HAGO vs. lighter distillates (distillate #2/#1, Jet A, Naphtha) at the GVEA facilities. (2013 was the Base Year for the Serious SIP inventory and was included to show the fuel transitions, in particular at the GVEA facilities associated with the switch from HAGO to lighter distillates.) As seen, there were generally modest changes (roughly within 10%) in annual throughput/fuel use between 2008, 2013 and 2019 for most facilities. The GVEA facilities were the biggest exception, using much less HAGO fuel in 2013 than in 2008 (although HAGO use increased at the Zehnder facility), but then increasing lighter distillate usage with the elimination of HAGO supply. This is important since HAGO has significantly higher $PM_{2.5}$ and SO_2 emissions per unit of fuel energy than the lighter distillate/Jet A/Naphtha fuels it also uses. Coal use at Doyon was 17% higher in 2013 than 2008, but then dropped in 2019 to 20% below the 2008 level.

[8] Since day-specific 2019 modeling episodes for the 5% SIP baseline year were not developed, there was no reason to obtain day- and hour-specific emissions or fuel use from facility operations in 2019.

Table 7.6-3
Comparison of 2019 and 2013 vs. 2008 Annual Fuel Use by Facility and Fuel Type

Facility ID	Facility Name	Calendar Year	HAGO (1000 gal/year)	Light Distillate (1000 gal/year)	Coal (tons/year)
109	GVEA Zehnder	2008	827	8	n/a
		2013	1,200	1	n/a
		2019	0	1,255	n/a
		% Change, 2008-2013	+45%	-87%	n/a
		% Change, 2008-2019	-100%	+14922%	n/a
110	GVEA North Pole	2008	5,634	23,054	n/a
		2013	2,764	23,345	n/a
		2019	0	37,459	n/a
		% Change, 2008-2013	-51%	+1%	n/a
		% Change, 2008-2019	-100%	+62%	n/a
315	Aurora Energy	2008	n/a	n/a	222,592
		2013	n/a	n/a	214,961
		2019	n/a	.	221,799
		% Change, 2008-2013	n/a	n/a	-3%
		% Change, 2008-2019	n/a	n/a	-0%
316	UA Fairbanks	2008	n/a	935	73,900
		2013	n/a	852	68,599
		2019	n/a	1,587	51,697
		% Change, 2008-2013	n/a	-9%	-7%
		% Change, 2008-2019	n/a	+70%	-30%
1121	Doyon (Fort Wainwright)	2008	n/a	n/a	246,250
		2013	n/a	n/a	288,702
		2019	n/a	n/a	196,378
		% Change, 2008-2013	n/a	n/a	+17%
		% Change, 2008-2019	n/a	n/a	-20%

Note: Fuel data in each year for Flint Hills Refinery and Eielson AFB were not available, only annual emissions.

Generally, each facility provided hourly $PM_{2.5}$ and SO_2 emission rates by individual emission unit. As explained in greater detail below, estimates of NO_x, VOC and NH_3

emission rates were developed from AP-42 based emission factors[9] (where fuel use data were explicitly provided) or from fuel-specific emission factor ratios.

Figure 7.6-1 through Figure 7.6-5 provide comparisons of $PM_{2.5}$, SO_2, NO_x, VOC and NH_3 emissions (for facilities reporting NH_3 emissions), respectively, for each source facility for which episodic data were collected. Within each figure, three sets of daily average emissions (in tons/day) are plotted for each facility, as described below.

1. ***2019 E1 Avg*** **– Episode 1 average daily emissions, scaled forward to 2019**
2. ***2019 E2 Avg*** **– Episode 2 average daily emissions, scaled forward to 2019**
3. ***2019 Annual*** **– 2019 annual average daily actual emissions (from DEC database)**

Though shown in each figure, 2019 emissions from Flint Hills Refinery are zero since the facility's refinery operations were shut down in 2014. The facility is included in these plots for continuity with previous SIPs.

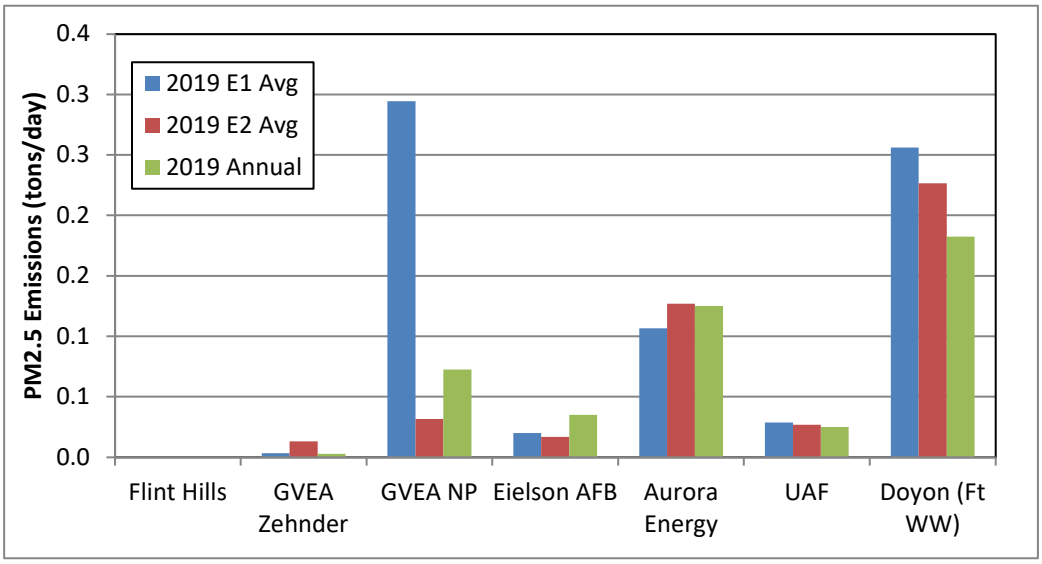


Figure 7.6-1. 2019 $PM_{2.5}$ Episodic vs. Annual Average Point Source Emissions (tons/day)

[9] **AP-42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources," Environmental Protection Agency, January 1995**.

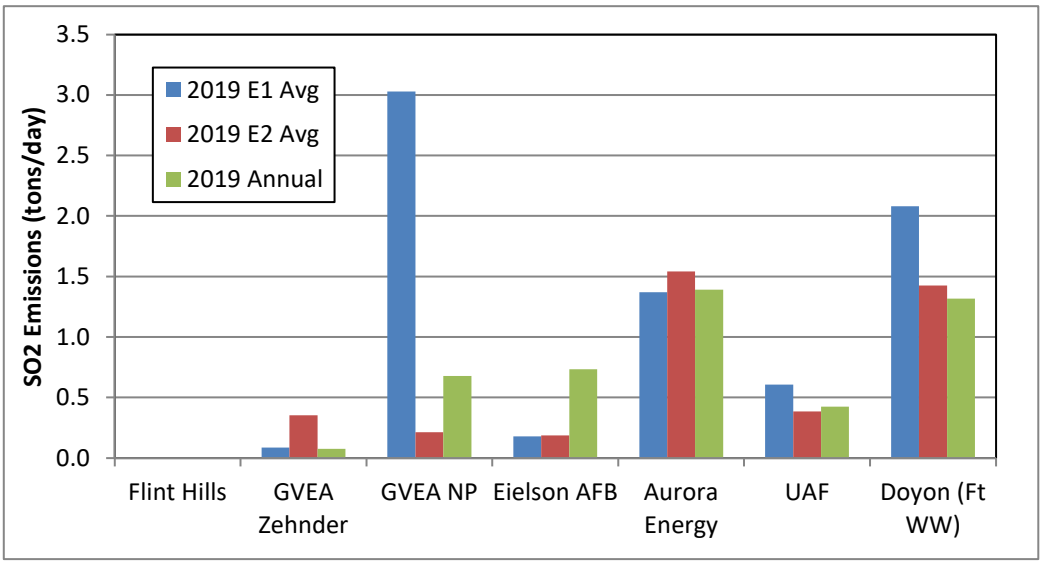


Figure 7.6-2. 2019 SO_2 Episodic vs. Annual Average Point Source Emissions (tons/day)

All five pollutant plots show two elements very clearly. First, the strong seasonal nature of emissions at many of the facilities is evidenced where episodic daily emissions are higher than annual average daily emissions. For example, as shown in Error! Reference source not found. **direct $PM_{2.5}$ emissions during the wintertime modeling episodes are much higher than the daily average over the entire year at both GVEA power plants and the Doyon facilities on the Fort Wainwright Army Base. This relates to the fact that more energy is needed for electric heat and power from these facilities during winter when temperatures are colder and nights are longer. Second, each plot shows which facilities are the major point source contributors for each pollutant.**

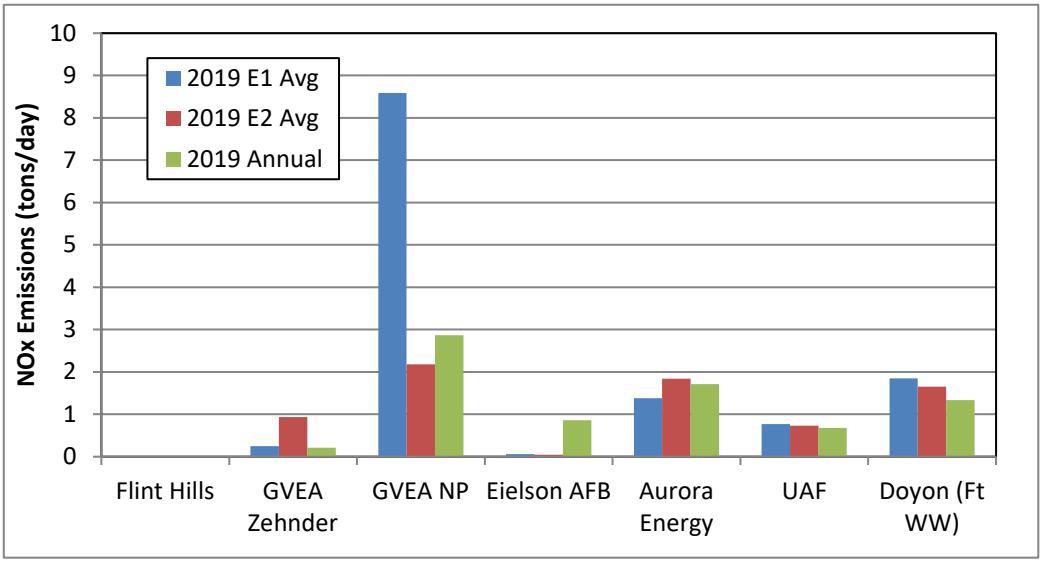


Figure 7.6-3. 2019 NO_x Episodic vs. Annual Average Point Source Emissions (tons/day)

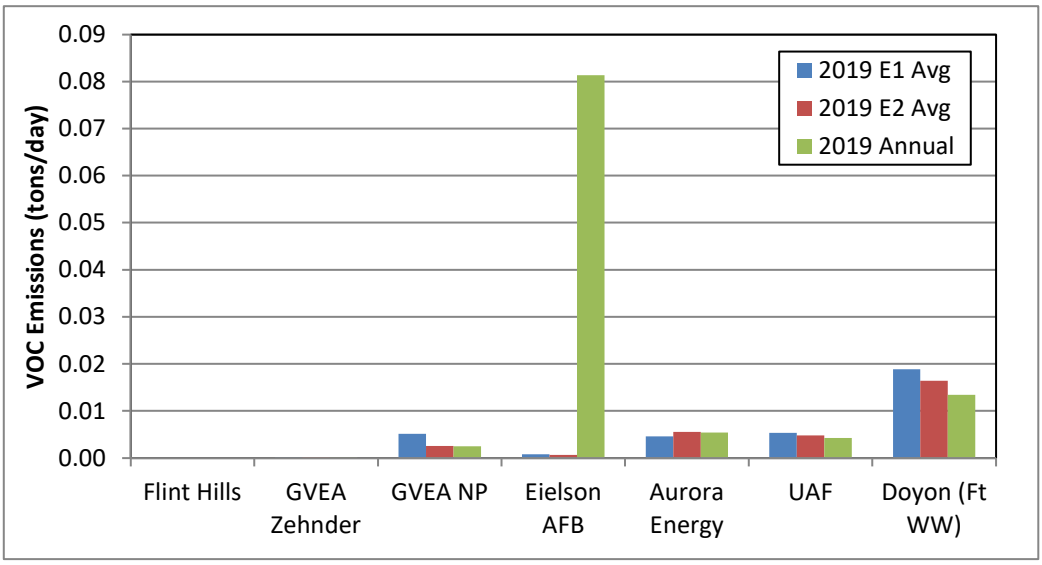
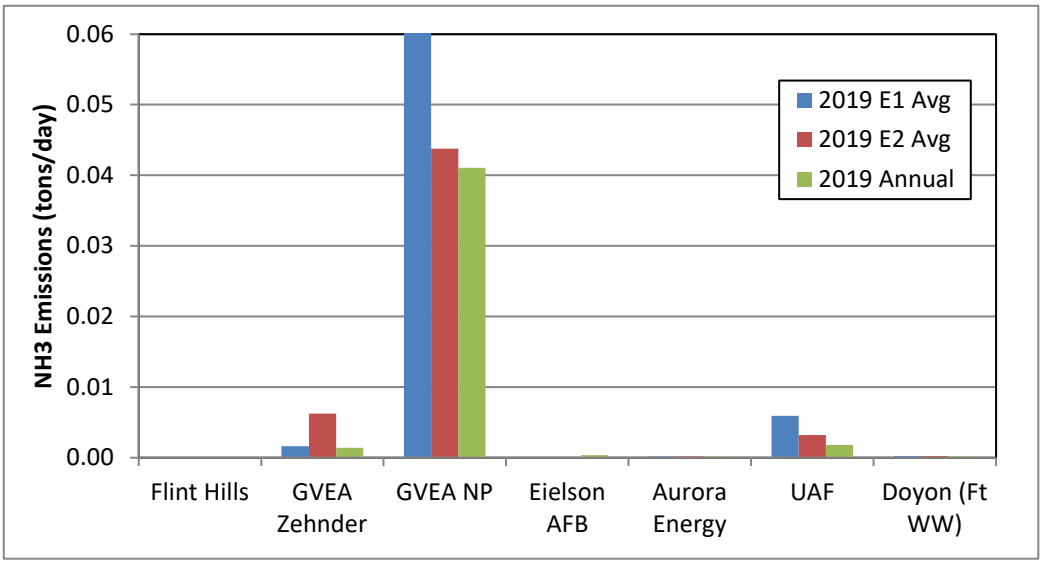


Figure 7.6-4. 2019 VOC Episodic vs. Annual Average Point Source Emissions (tons/day)



Note: NH_3 emissions were not reported from Flint Hills and Eielson AFB. Those for Aurora Energy and Doyon are too small to see on the scale of the plot.

Figure 7.6-5. 2019 NH_3 Episodic vs. Annual Average Point Source Emissions (tons/day)

Though not shown in Figure 7.6-1 through Figure 7.6-5, a cross-check of the 2008 to 2019 facility emissions scaling updates was performed to verify that scaled 2019 emissions did not exceed annual PTE limits for each facility.

In the modeling inventory, the episodic actual emissions for each point are represented on a day- and hour-specific basis. The E1 and E2 emission levels shown in the plots are averages compiled from the day- and hour-specific emissions across each modeling episode.

7.6.6.3 Space Heating Area Sources

Inventory assessments and source apportionment analysis performed to support initial development of the SIP identified space heating as the single largest source category of directly emitted $PM_{2.5}$. Thus, the 2019 Baseline inventory incorporated an exhaustive set of locally collected data in the FNSB that were used to estimate episodic wintertime space heating emissions by heating device type and fuel type. These local wintertime data and their use in generating space heating emissions are summarized below.

- ***Fairbanks Winter Home Heating Energy Model* – A multivariate predictive model of household space heating energy use was developed based on highly resolved (down to five-minute intervals) actual instrumented measurements of heating device use in a sample of FNSB homes during winter 2011 collected by the Cold Climate Housing Research Center (CCHRC) in Fairbanks. The energy model was calibrated based on the CCHRC measurements and predicted energy use by day and hour as a function of household size (sq ft), heating devices present (fireplaces, wood stoves, outdoor hydronic heaters, and oil heating devices) and day type (weekday/weekend).**

- ***Multiple Residential Heating Surveys* – Representations of area (ZIP code) specific wintertime heating device use and practices were developed from a series of annual telephone-based surveys of residential households within the nonattainment area, ranging in size from 300-700 households per survey. DEC conducted 300-household surveys in 2006, 2007 and 2010 and more robust 700-houshold surveys in 2011, 2012, 2013, 2014 and 2015 that also proportionately sampled cell phone-only households.[10] The 2011-2015 data, which encompassed a combined sample of over 3,500 households was used to develop space heating emissions for the 2019 Baseline inventory for this 2020 Amendment. These combined 2011-2015 survey results were used to develop estimates of the types and number of heating devices used during winter by 4 km square areas[11] within the nonattainment area. The survey data were also used to cross-check the energy model-based fuel use predictions as well as to identify and apportion wood use within key subgroups (certified vs. non-certified devices and purchased vs. user-cut wood, the latter of which reflects differences in moisture content that affects emissions). Special purpose surveys were also conducted that included a 2013 "Wood Tag" survey of wood-burning households that collected further detail on EPA-certified devices and a 2016 Postcard survey that sought to assess changes in wood use related to heating oil price decreases.**

- ***Fairbanks Wood Species Energy Content and Moisture Measurements* – CCHRC performed an additional study that measured wood drying practices and moisture content of commonly used wood species for space heating in the FNSB area. These**

[10] **Households with only with cell phones and no landline phone. Cell-only households had not been explicitly sampled in the 2010 and earlier surveys.**

[11] **Modeling grid cells were 1.33 km square. Device and fuel usage distributions from the 2011-2015 survey data were calculated by 4 km square areas (which consist of 3 × 3 sets of modeling grid cells) in order to achieve a minimum statistically sufficient sample size of a least 50 households per 4 km square area across the majority of the nonattainment area.**

measurements were combined with published wood species-specific energy content data and additional residential survey data (2013 Wood Tag Survey) under which respondents identified the types of wood they used to heat their homes. Birch, Spruce, and "Aspen" (i.e., Poplar) were identified as the three primary locally used wood species.

- ***Laboratory-Measured Emission Factors for Fairbanks Heating Devices*** **– An accredited testing laboratory, OMNI-Test Laboratory (OMNI), was contracted to perform a series of heating device emission tests using a sample of wood-burning and oil heating devices commonly used in the FNSB area in conjunction with samples of locally collected wood and heating oil. The primary purpose of this testing was to evaluate and, if necessary, update AP-42-based emission factors that were generally based on heating device technology circa 1990. The OMNI study provided a comprehensive, systematic attempt to quantify Fairbanks-specific, current technology-based emission factors from space heating appliances and fuels. The laboratory-based emission testing study consisted of 35 tests of nine space heating appliances, using six typical FNSB area fuels. Both direct PM and gaseous precursors (SO_2, NO_x, NH_3) were measured, along with PM elemental profiles. All emission tests were conducted at OMNI's laboratory in Portland, Oregon. Supporting solid fuel, liquid fuel, and bottom ash analyses were performed by Twin Ports Testing, Southwest Research Institute (SwRI), and Columbia Analytical Services, respectively. PM profiles of deposits on Teflon filters from dilution tunnel sampling were analyzed by Research Triangle Institute using XRF, ion chromatography, and thermal/optical analysis.**

Residential Space Heating Device Activity - As noted above, device and fuel usage rates were based on the combined 3,500+ households from the 2011-2015 Fairbanks Home Heating (HH) surveys to represent wintertime, episodic space heating activity in calendar year 2013, which is centered within the five-year survey data period. Table 7.6-4 provides a summary of key results from the HH surveys by individual survey year, and for the combined 2011-2015 survey period, averaged over the nonattainment area.

Below the sample sizes of each survey, winter season (Oct-Mar) device/fuel usage fractions are presented and show the breakdown of heating energy use by fuel type (with detailed breakdown for wood-burning devices). As shown in Table 7.6-4, roughly 75% of winter season heating energy is from heating oil (Central Oil, Portable Heater and Direct Vent devices). Wood heating make up roughly 22% of winter heating energy use, and notably rose from 19.2% in 2011 to 24.1% in 2014. This coincides with a period when heating oil prices in Fairbanks hovered near $4 per gallon, and as discussed later in Section 7.6.7.1, appears to have encouraged residents to burn more wood (a cheaper fuel) when heating oil costs were high.

Table 7.6-4
Key Results from 2011-2015 Fairbanks Home Heating Surveys

Metric	Fuel/Device Type	Survey Year					2011-2015 Combined
		2011	2012	2013	2014	2015	
Sample Size (households)		712	700	701	700	701	3,514
Winter Season Heating Energy Use Fractions	All Wood	19.2%	22.1%	21.4%	24.1%	20.3%	21.8%
	Fireplace	0.5%	0.8%	0.8%	0.7%	0.3%	0.7%
	Insert, Cordwood	1.0%	0.7%	0.8%	1.0%	0.9%	0.9%
	Stove, Cordwood	13.4%	17.6%	15.7%	18.8%	16.4%	16.6%
	Insert, Pellet	0.8%	0.6%	1.6%	1.8%	0.8%	1.1%
	Stove, Pellet	0.6%	0.6%	1.6%	1.6%	0.8%	1.1%
	Outdoor Wood Boiler	2.9%	1.9%	0.9%	0.2%	1.0%	1.5%
	Central Oil	70.9%	65.9%	73.4%	66.9%	74.5%	70.7%
	Portable/Kerosene Heat	0.9%	0.1%	0.8%	0.4%	0.4%	0.5%
	Direct Vent	4.4%	2.8%	2.4%	3.5%	2.9%	3.3%
	Natural Gas	2.3%	2.3%	1.0%	2.0%	0.5%	1.7%
	Coal Heat	0.3%	0.2%	0.6%	2.1%	0.4%	0.7%
	District Heat	2.0%	1.4%	0.4%	1.0%	1.0%	1.2%
Stove/Insert Cert. Type	Uncertified (<1988)	25.7%	22.7%	20.1%	14.4%	13.9%	19.1%
	Certified (≥1988)	74.3%	77.3%	79.9%	85.6%	86.1%	80.9%
Stove/Insert Tech. Type	Catalytic	39.3%	37.6%	45.6%	44.7%	42.4%	42.0%
	Non-Catalytic	60.7%	62.4%	54.4%	55.3%	57.6%	58.0%
Wood Source	Buy	27.0%	36.1%	35.4%	32.3%	37.4%	33.8%
	Cut Own Wood	61.9%	49.1%	47.1%	54.3%	47.9%	51.8%
	Both (Buy & Cut Own)	11.0%	14.8%	17.5%	13.4%	14.7%	14.4%

Table 7.6-4 also presents usage splits for other key survey elements. First, uncertified vs. EPA-certified wood stove or insert fractions (based on the age of the device) are shown to steadily drop from 25.7% in 2011 to 13.9% in 2015. The HH survey asked respondents if their wood stoves or inserts were purchased/installed before or after 1988, the year of EPA's initial New Source Performance Standards (NSPS) that established certification standards for new wood-burning devices.[12] This downward trend in uncertified devices make sense as older devices are retired and new certified wood stoves/inserts are purchased, either under or outside the Borough's Wood Stove Change Out Program. (Though not reflected in Table 7.6-4 the uncertified vs. EPA-certified device fractions from the HH surveys are adjusted to reflect the fact that some devices sold after 1988 are not certified as described in Appendix III.D.7.6.) Second, the distribution of EPA-certified devices by technology type (catalytic vs. non-catalytic) is also shown in Table 7.6-4 for each survey year and indicates that most existing EPA-certified devices are non-catalytic, the fraction of catalytic technology generally increased over the 2011-2015 survey period. Finally, fractions of the sources of wood are listed at the bottom of Table 7.6-4, showing that most wood is cut by respondents, rather than commercially purchased. As explained

[12] The question was intentionally designed this way to avoid potential inaccuracies arising if respondents were not certain their device was certified or could not easily see/identify a certification label on the wood device.

in greater detail in Appendix III.D.7.6, this Wood Source distribution is important because "Cut Own" wood tends to have lower moisture content than commercially purchased wood since it is generally seasoned longer before being burned.

As stated earlier in this sub-section, the combined 2011-2015 HH survey sample was used to represent residential space heating device and fuel use circa 2013, as opposed to just the 2013 survey data. The rationale behind this decision was twofold:

1. **Calendar year 2013 was centered within the 2011-2015 survey period, and any trends over the period (e.g., wood use, uncertified device fractions would be reasonably represented by the combined average over the period); and**

2. **Use of the combined data provided a roughly five-fold increase in sample size, which as explained in further detail in Appendix III.D.7.6 provided much higher statistical confidence in the usage fractions listed in** Error! Reference source not found.**, especially for smaller proportion device/fuel combinations such as Outdoor Wood Boilers.**

Although the residential space heating energy use data presented earlier in Table 7.6-4were listed as winter season usage percentages, the combined 2011-2015 HH survey data were integrated with the Fairbanks Winter Home Heating Energy Model to develop grid cell-specific estimates of day- and hour-specific heating energy use (in BTUs) for each modeling episode day. A parcel database obtained from the Borough containing building sizes within each residential, commercial, industrial and other (e.g., government) parcel was used within the framework of the Energy Model to determine the amounts of heated building space allocated within each grid cell. These calculations also incorporated the effects of wood moisture, accounting for the fact that wetter wood provides less "effective heating energy" than drier wood. The combined wood moisture content calculated for the 2019 Baseline inventory (weighting Buy and Cut Own wood use at different moisture levels) was 36.5%. Appendix III.D.7.6 describes these calculations in detail.

Finally, though not shown earlier in Table 7.6-4, data from the combined 2011-2015 HH surveys were tabulated to determine the usage fractions of #1 and #2 distillate heating oil in residential space heating. (One of the survey questions asked of oil-burning households was to estimate their usage of #1 and #2 in gallons.) From these responses, residential heating oil usage was estimated to be 68.2% #2 and 31.8% #1 heating oil.

Commercial Space Heating Activity – Space heating activity and emissions associated with fuel combustion in non-residential buildings were determined separately from residential space heating. (Hereafter, the term "commercial" space heating refers to that from all non-residential buildings including commercial, industrial and all other non-residential buildings.)

The aforementioned parcel/building size database was used to identify the amount of non-residential building space located within each modeling grid cell. Tabulated non-residential building space was combined with an Alaska commercial building heating

energy demand factor developed by CCHRC and daily Heating Degree Day (HDD) data for the historical modeling episodes to estimate commercial space heating energy demand.[13]

Under the Moderate SIP, commercial space heating energy usage was estimated to be 98% from heating oil and 2% from natural gas. This estimate was reviewed under the 2020 Amendment to the Serious SIP and maintained based on the fact that there was little change in the number of commercial customers using natural gas between the 2008 Moderate SIP baseline and the 2020 Amendment's 2019 Baseline inventory. Based on information provided by one of the local heating oil suppliers in commenting on the Serious SIP inventories combined with the #1 and #2 heating oil splits in the residential sector, it was estimated that commercial fuel oil was almost entirely #1 distillate oil. So commercial heating oil was assumed to be 100% #1 distillate.

In addition, DEC conducted a survey in early 2017 of solid fuel burning (wood or coal) in commercial buildings. The survey utilized a local business database provided by the Borough's Planning Department and group businesses into categories more or less likely to utilize a solid fuel burning appliance. Roughly 30 commercial businesses were found to utilize solid fuel burning and identified the type of device used. Many also provided estimates of their solid fuel usage. For those that did not, estimates were developed based on the building size assuming solid fuel burning was a secondary, rather than primary heating source. As shown later, commercial solid fuel space heating emissions were found to be very small compared to the residential sector based on these estimates.

Projection of Survey-Based Activity from 2013 to 2019 – Given the short period between completion and submittal of the Serious SIP and development of this 2020 Amendment to the Serious SIP, there was insufficient time to perform additional home heating surveys beyond those conducted as described earlier. Thus, it was necessary to account for expected changes in space heating energy demand and fuel usage between 2013 (the centered year of the HH surveys) and 2019, the baseline year for this 2020 SIP Amendment. Two elements were accounted for in translating 2013 space heating energy and fuel usage to 2019:

1. ***Household Energy Usage Differences* – Representation of population-driven differences in heating energy usage between 2013 and 2019.**

2. ***Heating Oil Price-Driven Fuel Shifts* – Changes in relative energy use between wood and heating oil triggered by changes in heating oil prices over time (which are more volatile that wood prices). As explained in greater detail later in Section 7.6.7, locally collected data were analyzed in support of the Serious SIP by an independent economist that established a wood-heating oil cross-price elasticity that accounts for increases in wood use and heating oil prices increase (and vice versa) This cross-price elasticity relationship was used to adjust the mix in 2019 wood vs. heating oil**

[13] The energy demand factor was in units of BTU/HDD/ft^2/year. Commercial space heating energy per day was then calculated by multiplying the energy demand factor by building space (in ft^2) and day-specific HDDs.

use relative to that for 2013 based on the difference in Fairbanks heating oil prices between 2019 and 2013.

As discussed further in Section 7.6.7, growth rates in housing units developed by the Alaska Department of Transportation and Public Facilities (ADOT) and Kittelson & Associates in support of the Fairbanks 2045 Metropolitan Transportation Plan were used to scale population/housing unit space heating energy usage from 2013 to 2019. These housing unit growth rates were developed by traffic analysis zone (TAZ) and mapped to each grid cell in the modeling domain. The average annual housing unit growth rate (across all grid cells) from 2013 to 2019 was 0.9% per year.

Cross-price elasticity adjustments to the split of wood vs. oil-based space heating energy usage between 2013 and 2019 for the 2020 Amendment to the Serious SIP baseline inventory were also identical to those applied under the Serious SIP to project space heating fuel usage from 2013 to 2019. Under the Serious SIP historical annual Fairbanks heating oil price data through 2017 were forecasted to 2019 based on U.S. Energy Information Administration projections. That forecasted price was $2.89/gallon. For this 2020 SIP Amendment, actual 2019 prices (those corresponding to winter 2018-2019) were available and obtained[14] in early 2020 from the Borough Community Planning Department. The actual 2019 Fairbanks oil price was $2.90/gallon, a small one-cent difference between that forecasted to 2019 under the Serious SIP. The resulting elasticity-driven wood use shift for the 2020 Amendment's 2019 Baseline inventory (relative to 2013) was -5.94% (i.e., a reduction due to the decrease in oil price from 2013 to 2019. (This adjustment factor for the Serious SIP 2019 inventory was a nearly identical 5.99%.)

Space Heating Emission Factors - Space heating emissions were estimated using OMNI-based results where available for specific devices and AP-42-based estimates for devices for which OMNI tests were not conducted with one exception: PM emission factors for residential natural gas combustion. A review of the AP-42 emission factor assigned to residential natural gas determined that this emission factor was based on testing of industrial and utility boilers in the early 1990s.[15] In 2009, Brookhaven National Labs conducted a testing study[16] that included measurement of emissions from smaller-scale residential natural gas boilers and furnaces. The residential natural gas devices tested included both cast-iron and condensing residential boilers and a furnace. The PM emission factor from these three devices were averaged and used to represent PM emissions for residential natural gas use. This Brookhaven-based emission factor (4.88×10^{-5} lb/mmBTU) is over two orders of magnitude below that used in AP-42 and is believed to be more representative of PM emissions from residential natural gas combustion.

Table 7.6-5 shows the device and fuel types resolved in estimating space heating emissions for the modeling inventory, their assigned SCC codes, and the source of the emission

[14] Email from Stephanie Pearson, Fairbanks Borough Community Planning Department, January 8, 2020.

[15] Eastern Research Group, "Emission Factor Documentation for AP-42 Section 1.4 Natural Gas Combustion," March 1998.

[16] R. McDonald, "Evaluation of Gas, Oil and Wood Pellet Fueled Residential Heating System Emissions Characteristics," Brookhaven National Laboratory, BNL-91286-2009-IR, December 2009.

factors (OMNI testing, AP-42 or Brookhaven-based) used in calculating emissions for each device.

Episodic day- and hour-specific emissions from space heating fuel combustion were calculated by combining heating energy use estimates from the Fairbanks Energy Model with 4 km square grid cell device distributions from the local survey data (along with wood species mix and moisture content data). Estimates were gridded to the smaller 1.33 km modeling grid cells using block-level GIS shapefile counts of housing units from the 2010 U.S. Census combined with 2013 block-group level housing unit estimates from the American Community Survey (ACS).[17] The grid cell-specific source activity estimates were then combined with emission factors for the devices listed in Table 7.6-5 to estimate space heating emissions by grid cell.

Table 7.6-5
Fairbanks Space Heating Devices and Fuel Types and Source of Emission Factors

Device Type	SCC Code	Emission Factor
Residential Wood-Burning Devices		
Fireplace, No Insert	2104008100	AP-42
Fireplace, With Insert - Non-EPA Certified	2104008210	AP-42
Fireplace, With Insert - EPA Certified Non-Catalytic	2104008220	AP-42
Fireplace, With Insert - EPA Certified Catalytic	2104008230	AP-42
Woodstove - Non-EPA Certified	2104008310	OMNI
Woodstove - EPA Certified Non-Catalytic	2104008320	OMNI
Woodstove - EPA Certified Catalytic	2104008330	OMNI
Pellet Stove (Exempt)	2104008410	OMNI
Pellet Stove (EPA Certified)	2104008420	OMNI
OWB (Hydronic Heater) - Unqualified	2104008610	OMNI
OWB (Hydronic Heater) - Phase 2	2104008640	OMNI
Other Heating Devices		
Central Oil (Weighted # 1 & #2), Residential	2104004000	OMNI
Central Oil (Weighted # 1 & #2), Commercial	2103004001	OMNI
Portable Heater: 43% Kerosene & 57% Fuel Oil	2104004000	AP-42
Direct Vent Oil Heater	2104004000	AP-42
Natural Gas - Residential	2104006010	Brookhaven, AP-42
Natural Gas - Commercial, small uncontrolled	2103006000	AP-42
Coal Boiler – Residential	2104002000	OMNI
Coal Boiler – Commercial	2103002000	OMNI[a]
Wood Devices - Commercial	2103008000	Device Specific[b]
Waste Oil Burning	2102012000	OMNI

[a] Assumed same emission factors as residential coal heaters.

[b] Used wood burning device specific emission factors from residential sector.

The space heating emissions were passed to the SMOKE inventory pre-processing model on an episodic daily and hourly basis. Earlier versions of the SMOKE model accepted only nonpoint or area source emissions that were temporally resolved using independent monthly, day of week, and diurnal profiles. A modified version of

[17] The American Community Survey is an on-going annual survey of households and businesses conducted by the U.S. Census Bureau between full decadal Census counts (https://www.census.gov/programs-surveys/acs/).

SMOKE was developed for the SIP modeling inventories to also accept area source emissions in a similar fashion to which day- and hour-specific episodic point source emissions can be supplied to the model. This was critically important in preserving the actual historical temporal resolution reflected in the space heating portion of the modeling inventory when applied in the downstream attainment modeling.

7.6.6.4 Other Area Sources

Modeling inventory emissions for all other stationary area sources other than those related to space heating were calculated more simply, although still using local data where available. The data sources used to estimate "Other" area source emissions were as follows:

1. **DEC's Minor Stationary Source emissions database (for calendar year 2014);**
2. **Locally collected data for coffee roasting facilities within the nonattainment area; and**
3. **EPA's 2014 National Emission Inventory (NEI).**

First, emissions for sources within the Fairbanks North Star Borough were extracted from the 2014 Minor Source database for the following source types and SCCs:

- **Batch Mix Asphalt Plant (SCC 30500247);**
- **Drum Hot Mix Asphalt Plants (SCC 30500258);**
- **Gold Mine (SCC 10200502);**
- **Hospital (SCC 20200402);**
- **Refinery (SCC 30600106);**
- **Rock Crusher (SCC 30504030); and**
- **Wood Production (SCC 10300208).**

Emissions for these sources from the 2014 Minor Source file were actual emissions in tons per year. They were assumed to be constant over the year.

Second, a Fairbanks Business database (with confirmation from Borough staff) was used to identify a total of four facilities within the nonattainment area that use on-site coffee roasters. These businesses were contacted and two of the four provided data on annual roasting throughput (tons of beans roasted). Throughput was conservatively estimated for the two non-reporting facilities based on the maximum from those that reported their throughput. Emission factors for PM, VOC and NOx from EPA's WebFIRE AP-42 database for batch roasters were used to calculate emissions. (No emission factors were available for SO_2 or NH_3). Uncontrolled emission factors were applied to three of the four facilities. The other facility utilizes a thermal oxidizer; its emission factors were based on WebFIRE factors for a batch roaster with a thermal oxidizer. Coffee roasting emissions were assumed to be constant throughout the year.

Third, the 2014 NEI was used to represent SCC-level annual emissions for all other remaining area source categories that included fugitive dust, commercial cooking, solvent

use, forest and structural fires and petroleum project storage and transfer. A number of source categories within the Other Area Source sector from the NEI were estimated to have no emissions during episodic wintertime conditions. These "zeroed" wintertime source categories are listed below (with SCC codes in parentheses).

- **Fugitive Dust, Paved Roads (2294000000)**
- **Fugitive Dust, Unpaved Roads (2296000000)**
- **Industrial Processes, Petroleum Refining, Asphalt Paving Materials (2306010000)**
- **Solvent Utilization, Surface Coating, Architectural Coatings (2401001000)**
- **Solvent Utilization, Miscellaneous Commercial, Asphalt Application (2461020000)**
- **Miscellaneous Area Sources, Other Combustion, Forest Wildfires (2810001000)**
- **Miscellaneous Area Sources, Other Combustion, Firefighting Training (2810035000)**

Some of these source categories, notably those for fugitive dust and forest wildfires, have significant summer season (and annual average) emissions; however, emissions from these categories do not occur during winter conditions in Fairbanks when road and land surfaces are covered by snow and ice.

Finally, 2014 emissions from the Minor Stationary Source database and the NEI were forecasted to 2019 using employment projections for Fairbanks developed by ADOT and Kittelson for the 2045 Metropolitan Transportation Plan. The 2014-2019 employment growth factor for Fairbanks was 1.059, reflecting a 1.2% annualized increase from 2014 to 2019. Thus, 2014 Other Area Source emissions were scaled to 2019 by multiplying 2014 emissions by 1.059.

7.6.6.5 On-Road Mobile Sources

Emissions from on-road motor vehicles were developed for the 2019 Baseline inventory using locally developed vehicle travel activity estimates and fleet characteristics as inputs to EPA's MOVES2014b vehicle emissions model. To support the gridded structure and episodic (daily/hourly) emission estimates of the modeling inventory, MOVES2014b was used to generate detailed fleet emission rates and was combined with EPA's SMOKE-MOVES integration tool to pass the highly resolved and emission process-specific emission rates into input structures required by the SMOKE inventory pre-processing model.

For the 2019 Baseline inventory, MOVES inputs were based primarily on data gathered in support of the Fairbanks Metropolitan Area Transportation System (FMATS) 2045 Metropolitan Transportation Program (MTP). FMATS (now FAST Planning) is the Metropolitan Planning Organization (MPO) for the FNSB. Inputs were derived from local transportation modeling runs conducted to support the 2045 MTP, vehicle registration data, and other local data. The transportation and other vehicle activity data are discussed below. The remaining fleet characteristics and other MOVES inputs are summarized in Section III.D.7.14 and discussed in detail in Appendix III.D.7.6.

Regional Travel Model Vehicle Activity – Vehicle activity on the FMATS/FAST Planning transportation network was based on the TransCAD travel demand modeling performed for the 2045 MTP. The TransCAD modeling network covers the entire FNSB $PM_{2.5}$ nonattainment area and its major links extend beyond the nonattainment area boundary, as shown in

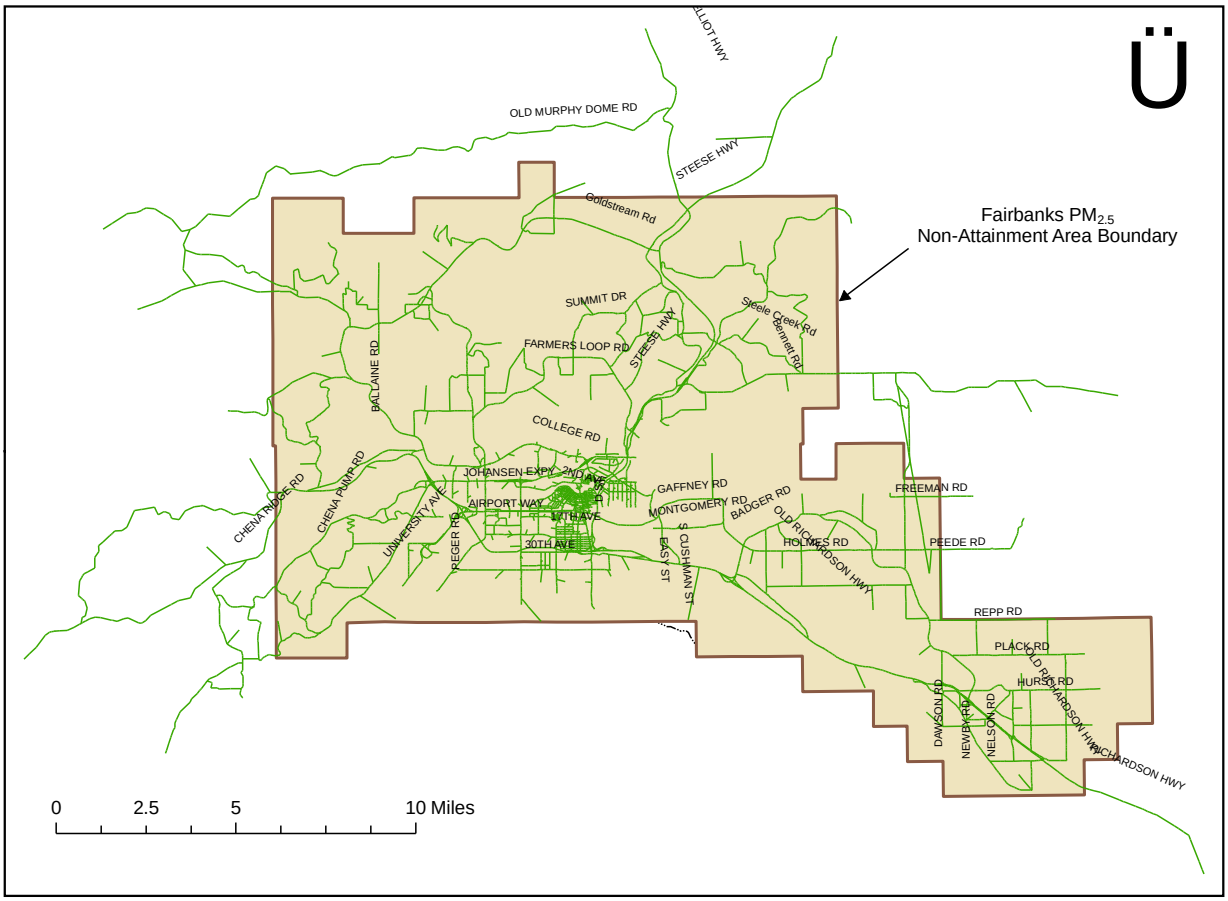


Figure 7.6-6.

TransCAD was configured using 2010 U.S. Census-based socioeconomic data. TransCAD modeling was performed for a 2013 base year and a projected 2045 horizon year. Projected population and household data relied on Census 2010 projections and a 1.1% annual growth rate in forecasted employment from 2010 to 2013 based on the information from the Institute of Social and Economic Research (ISER) at the University of Alaska, Anchorage.

Link-level TransCAD outputs were processed to develop several of the travel activity related inputs required by MOVES. Vehicle miles traveled (VMT) tabulated across the TransCAD network for the 2013 base year, key intermediate years 2019 and 2024, and the 2045 MTP horizon year are presented in Table 7.6-6. VMT growth factors (relative to 2013 levels) are listed at the bottom of Table 7.6-6. These growth factors translate to annualized VMT growth across the nonattainment area of 1.5% from 2013-2045 and 2.4%

from 2019-2024. The higher projected VMT growth during the latter 2019-2024 period is largely attributed to population and VMT travel growth associated with the deployment of the F-35 jet squadron at Eielson Air Force Base during this period.

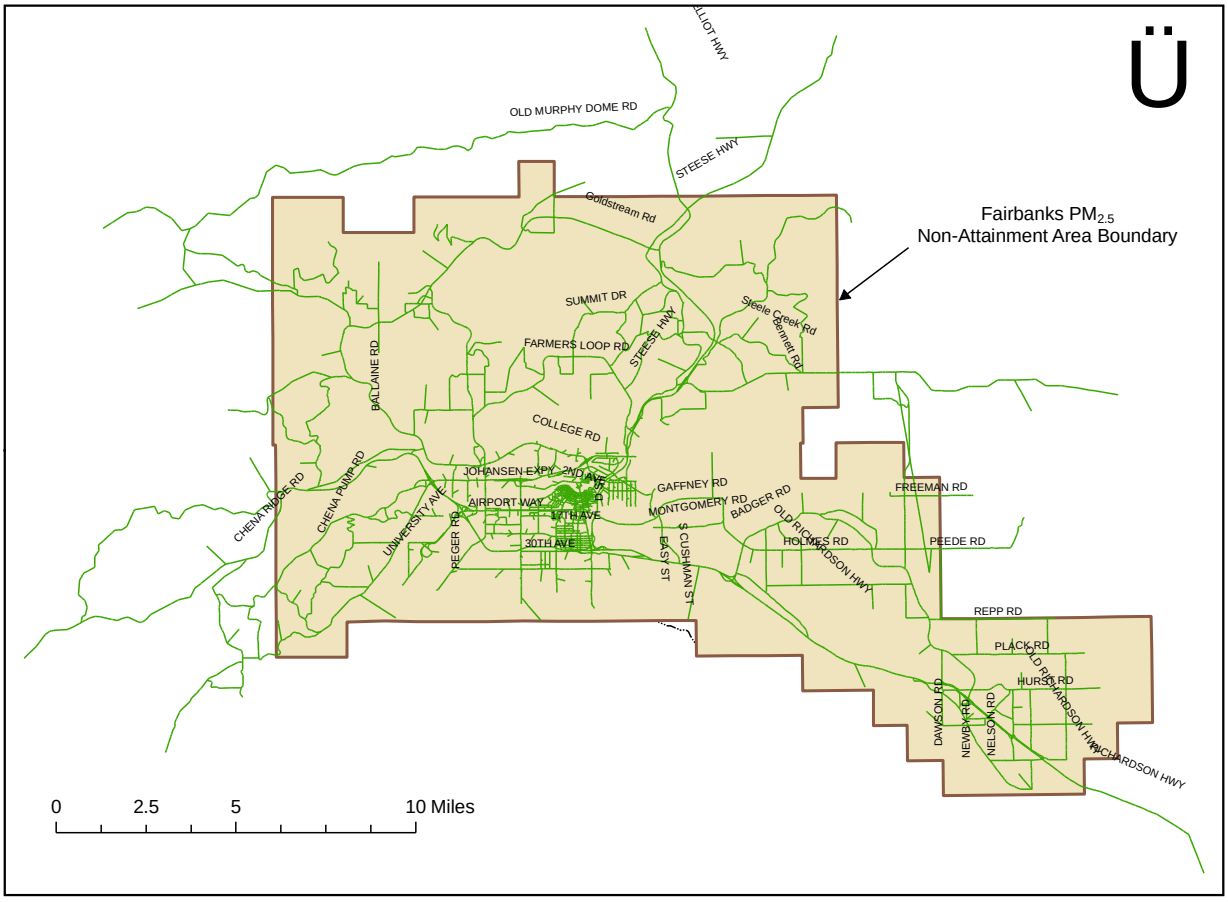


Figure 7.6-6. FMATS/FAST Planning TransCAD Modeling Network

Table 7.6-6
TransCAD Average Daily VMT by Analysis Year and Daily Period

Period / Vehicle Type	PM Nonattainment Area			
	2013	2019	2024	2045
Daily Period				
AM Peak (AM)	205,465	220,221	244,801	320,515
PM Peak (PM)	400,283	439,227	495,365	662,054
Off-Peak (OP)	1,092,896	1,195,145	1,345,403	1,774,618
Total Daily VMT	1,698,644	1,854,594	2,085,569	2,757,187
% Change (from 2013)	-	1.092	1.228	1.623

Vehicle Activity Beyond FMATS/FAST Planning Network – The geographic extent of the FMATS/FAST Planning network covers a small portion of the entire Grid 3 attainment modeling domain. Traffic density in the broader Alaskan interior is likely to be less than that concentrated in the FNSB nonattainment area (and have less impact on ambient air quality in Fairbanks). Nevertheless, for completeness, link-level travel estimates for major roadways beyond the FMATS/Fast Planning network (and Fairbanks NA Area) were developed using a spatial (ArcGIS-compatible) "Road Centerline" polyline coverage for the Interior Alaska region developed by the Alaska Department of Transportation and Public Facilities (ADOT&PF). This GIS layer identified locations of major highway/arterial routes within the Grid 3 domain broken down into individual milepost (MP) segments.

These road centerline segments are shown in red in

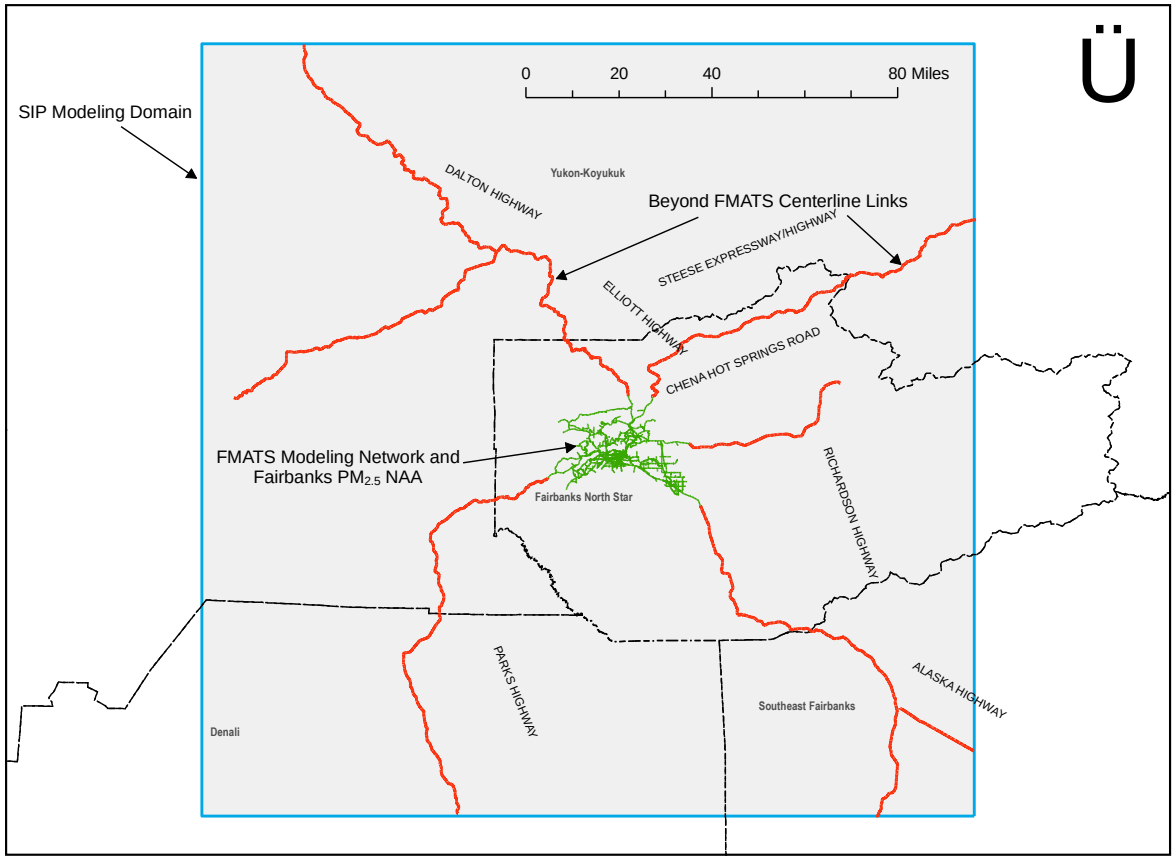


Figure 7.6-7 **along with the smaller FMATS/FAST Planning link network (green lines) and the extent of the SIP Grid 3 modeling domain (blue rectangle). Annual average daily traffic volumes (AADT) and VMT (determined by multiplying volume by segment length) were assigned to each segment based on a spreadsheet database of calendar year 2013 traffic volume data compiled by ADOT&PF's Northern Region office. A Linear Reference System (LRS) approach was used to spatially assign volume and VMT data for each segment in the spreadsheet database to the links in the Road Centerline layer based on the route identifier number (CDS_NUM) and lineal milepost value.**

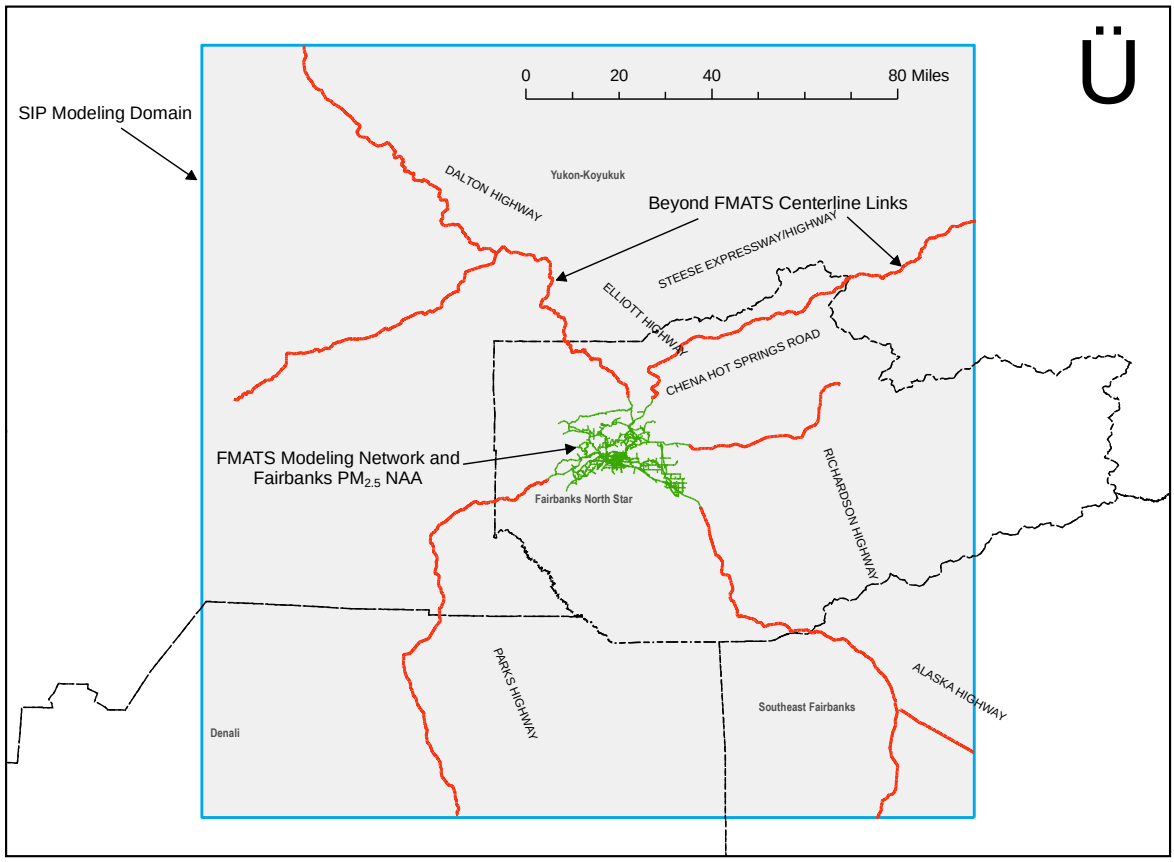


Figure 7.6-7. Additional ADOT&PF Roadway Links beyond FMATS/FAST Planning Network

Fleet Characteristics – Vehicle age distributions and fleet mix characteristics (e.g., Alternative Vehicle Fuel and Technology inputs) were developed using Alaska DMV registration data obtained in April 2018 (updating the 2014 DMV data used in the Serious SIP), coupled with earlier wintertime parking lot survey data collected by DEC to support the Moderate and Serious SIPs. Multiple parking lots survey have consistently found that older vehicles are operated less in the FNSB area during winter due to drivability concerns associated with the arctic climate. The parking lot data were used to adjust the DMV-based age distributions for light-duty vehicles to reflect this lowered operation of older vehicles during winter. In developing the episodic inputs, motorcycles were also assumed to not operate during harsh winter conditions and their populations were zeroed out (consistent with the approach applied in the Moderate and Serious SIP.)

7.6.6.6 Non-Road Mobile Sources

Non-road sources encompass all mobile sources that are not on-road vehicles.[18] They include recreational and commercial off-road vehicles and equipment as well as aircraft, locomotives, recreational pleasure craft (boats) and marine vessels. (Neither commercial marine nor recreational vessel emissions are contained in the modeling inventory, as they do not operate in the arctic conditions experienced in the Fairbanks area modeling domain during the winter.)

MOVES2014b-Based – Non-road emissions were estimated using EPA's latest MOVES model, MOVES2014b (EPA integrated what used to be a standalone model for estimating non-road mobile source emissions, called NONROAD, into MOVES2014). According to EPA's MOVES release notes,[19] MOVES2014b contains significant improvements in estimating non-road emissions relative to its predecessor, MOVES2014a (On-road emissions are identical in MOVES2014a and MOVES2014b). The non-road emissions option within MOVES2014b was used to generate emissions from the following types of non-road vehicles and equipment:

- **Recreational vehicles (e.g., all-terrain vehicles, off-road motorcycles, snowmobiles);**
- **Logging equipment (e.g., chain saws);**
- **Agricultural equipment (e.g., tractors);**
- **Commercial equipment (e.g., welders and compressors);**
- **Construction and mining equipment (e.g., graders and backhoes);**
- **Industrial equipment (e.g., forklifts and sweepers);**
- **Residential and commercial lawn and garden equipment (e.g., leaf and snow blowers);**
- **Locomotive support/railway maintenance equipment (but not locomotives); and**
- **Aircraft ground support equipment[2020] (but not aircraft).**

It is important to note that none of these non-road vehicle and equipment types listed above were federally regulated until the mid-1990s. (As parenthetically indicated for the last two equipment categories in the list above, MOVES2014b estimates emissions of support equipment for the rail and air sectors, but emissions from locomotives and aircraft are not addressed by MOVES2014b and were calculated separately using other models/methods as described later within this subsection.)

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[18] Although recent versions of EPA's NEI inventories treat emissions for aircraft and supporting equipment and rail yard locomotive emissions as stationary sources, emissions from these sources were "traditionally" located within the Non-Road source sector. For consistency with the Moderate SIP, these sources are similarly grouped within the Non-Road sector.

[19] https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

[20] Although MOVES2014b can be configured to also estimate emissions from airport ground support equipment (GSE), GSE emissions were estimated using the AEDT model as described later in this sub-section.

Default equipment populations and activity levels in MOVES2014b are based on national averages, then scaled down to represent smaller geographic areas on the basis of human population and proximity to recreational, industrial, and commercial facilities. EPA recognizes the limitations inherent in this "top-down" approach and realizes that locally generated inputs to the model will increase the accuracy of the resulting output. Therefore, in cases where data were available (most notably snowmobiles and snow blowers), locally derived inputs that more accurately reflect the equipment population, growth rates, and wintertime activity levels in the Fairbanks nonattainment area were substituted for EPA's default input values.

Nonexistent Wintertime Activity – Due to the severe outdoor weather conditions present in the FNSB during the winter months, Fairbanks Borough staff determined that there is zero wintertime activity for several different equipment categories. Therefore, all activity and corresponding emissions for the following non-road equipment categories were removed from the episodic wintertime modeling inventory:

- **Lawn and Garden;**
- **Agricultural Equipment;**
- **Logging Equipment;**
- **Pleasure Craft (i.e., personal watercraft, inboard and sterndrive motor boats);**
- **Selected Recreational Equipment (i.e., golf carts, ATVs, off-road motorcycles); and**
- **Commercial Equipment (i.e., generator sets, pressure washers, welders, pumps, A/C refrigeration units).**

Locomotive Emissions – Emissions for two types of locomotive activity were included in the emission inventory:

1) ***Line-Haul* – locomotive emissions along rail lines within the modeling domain (from Healy to Fairbanks and Fairbanks to Eielson Air Force Base); and**

2) ***Yard Switching* – locomotive emissions from train switching activities within the Fairbanks and Eielson rail yards.**

Information on wintertime train activity (circa 2013) was obtained from the Alaska Railroad Corporation[21] (ARRC), the sole rail utility operating within the modeling domain, providing both passenger and freight service. These activity data were combined with locomotive emission factors published by EPA[22] to estimate rail emissions within the emission inventory.

[21] Email from Matthew Kelzenberg, Alaska Railroad Corporation to Alex Edwards, Alaska Department of Environmental Conservation, July 19, 2016.

[22] "Emission Factors for Locomotives," U.S. Environmental Protection Agency, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009.

Aircraft and Associated Airfield Emissions – Emissions were estimated from aircraft operations at three regional airfields within the modeling domain: (1) Fairbanks International Airport (FAI); (2) Fort Wainwright Army Post[23] (FBK); and (3) Eielson Air Force Base (EIL). The aircraft emissions were developed using the Federal Aviation Administration's (FAA) AEDT emissions model. AEDT considers the physical characteristics of each airport along with detailed meteorological and operations information to estimate the overall emissions of aircraft, ground support equipment (GSE), and auxiliary power units (APUs) at each airport.

The AEDT model requires as input detailed information on landings and take-offs (LTO) for each aircraft type in order to assign GSE and estimate the associated emissions. Each LTO is assumed to comprise six distinct aircraft related emissions modes: startup, taxi out, take off, climb out, approach, and taxi in. The AEDT modeled defaults for time in mode and angle of climb out and approach were used for purposes of this analysis. To properly allocate aircraft emissions to each vertical layer of analysis (elevation above ground level), aircraft emissions were estimated for each mode and ascribed to a specific vertical layer.

Appendix III.D.7.6 provides detailed descriptions of the activity inputs, MOVES2014b, AEDT, and locomotive emission modeling used to generate emissions for the Non-Road sector of the modeling inventory.

7.6.6.7 Modeling and Planning Inventory Processing

Modeling Inventory Assembly and Pre-Processing – Emissions estimates across all sectors of the modeling inventory were generated at the SCC level and either directly gridded into the 1.3 km cells of the Grid 3 modeling domain (e.g., for point and space heating area sources) or assembled into spatial surrogate profiles for use within the SMOKE inventory pre-processing model.

For the three key source sectors (Point, Space Heating Area and On-Road Mobile), emissions were also temporally supplied to SMOKE on a day- and an hour-specific basis for each of the 35 historical days encompassing the two attainment modeling episodes. For the remaining two source sectors (Other Area and Non-Road Mobile), emissions were temporally supplied to SMOKE using SCC-specific monthly, day of week and diurnal profiles based on surrogates described in Appendix III.D.7.6.

Another key element in preparing the modeling inventory for processing in SMOKE consisted of the assignment of particulate matter (PM) speciation profiles to each source category (based on SCC code) in the inventory. These PM speciation profiles identify the distribution of share of each key PM component within overall direct $PM_{2.5}$ emissions and include primary organic carbon (POC), primary elemental carbon (PEC), primary sulfate (PSO_4), primary nitrate (PNO_3) and other primary (which represents all other remaining directly emitted $PM_{2.5}$ species).

[23] **Formerly Ladd Air Force Base**.

With one exception, particulate matter and gaseous speciation profiles were based on EPA's SPECIATE database (circa June 2018) and 2014v7 modeling platform (which assigns profiles to specific SCC codes). The exception was the SCC codes for space heating emissions that were based on aforementioned OMNI Laboratory testing (see Error! Reference source not found.). For these SCC codes, speciated PM data collected by OMNI during the device testing were used since they were available and matched with the total PM emission factors developed from the testing.

Planning Inventory Processing – As explained earlier in Section 7.6.1.3, DEC has chosen to represent the seasonal planning inventory requirement for the 24-hour $PM_{2.5}$ NAAQS to be by the average of modeling episode day emissions. Thus the difference between modeling and planning inventory processing is that the planning inventory is averaged over the modeling episode days and represents emissions within the nonattainment area portion of the modeling domain, while the modeling inventory is spatially gridded over the entire domain and contains day and hour specific emissions.

7.6.6.8 2019 Baseline Emissions

Emission Summaries and Sector Breakdowns - 2019 Baseline inventory emissions for the 2020 Amendment to the Serious SIP were calculated using the data sources and methodologies summarized in the preceding paragraphs were tabulated by source sector and key subcategory and are presented as follows.

Table 7.6-7 shows 2019 Baseline emissions tabulated by source sector. (The Space Heating sector is further broken out into key fuel-specific subcategories.) Emissions are shown for both the entire Grid 3 modeling domain (Modeling Inventory) and the smaller $PM_{2.5}$ nonattainment area (Planning Inventory) and are presented on an average daily basis over the 35 episode days.

Table 7.6-7
2019 Baseline Episode Average Daily Emissions (tons/day) by Source Sector

	Modeling Inventory *Grid 3 Domain Emissions (tons/day)*					*Planning Inventory* *NA Area Emissions (tons/day)*				
Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point Sources	0.59	10.36	5.87	0.03	0.073	0.57	10.31	5.68	0.03	0.073
Area, Space Heating	2.21	2.61	4.16	9.55	0.145	1.91	2.43	3.88	8.60	0.132
Area, Space Heat, Wood	2.05	0.45	0.17	9.31	0.096	1.77	0.39	0.16	8.38	0.086
Area, Space Heat, Oil	0.07	1.94	3.87	0.11	0.004	0.06	1.82	3.62	0.10	0.004
Area, Space Heat, Coal	0.08	0.06	0.10	0.12	0.016	0.07	0.05	0.09	0.11	0.014
Area, Space Heat, Other	0.01	0.17	0.02	0.01	0.029	0.01	0.17	0.02	0.01	0.029
Area, Other	0.24	0.38	0.03	2.25	0.050	0.22	0.36	0.03	2.10	0.046
On-Road Mobile	0.27	2.30	0.01	4.90	0.055	0.22	1.70	0.01	3.83	0.040
Non-Road Mobile	0.36	1.75	7.78	5.26	0.003	0.26	0.94	5.41	4.16	0.002
TOTALS	3.67	17.40	17.85	22.00	0.325	3.17	15.73	15.01	18.72	0.293

As seen in Table 7.6-7, directly-emitted $PM_{2.5}$ in the 2019 Baseline inventory is dominated by space heating emissions and almost entirely from wood-burning devices. Within the nonattainment area, wood-burning space heating contributes 1.91 tons/day of the total 3.17 tons/day of direct $PM_{2.5}$ from all sources, which is about 56%. For the gaseous precursor pollutants, point sources are the major contributors of NOx while SO_2 emissions are dominated by aircraft (within the non-road mobile sector) and point sources. Most VOC and NH_3 emissions are produced by wood-burning space heating, with other contributions from mobile sources.

(Detailed tabulations of 2020 Amendment's 2019 Baseline inventory emissions by SCC code are contained in Appendix III.D.7.6, including separate tabulations of filterable and condensable $PM_{2.5}$ components.)

To provide a clearer picture of the relative emissions contributions of each source sector, Figure 7.6-8 through Figure 7.6-12 provide "pie chart" breakdowns (as a percentage of total emissions) for $PM_{2.5}$, SO_2, NO_x, VOC, and NH_3 emissions, respectively, within the nonattainment area. (The breakdowns are similar for the larger Grid 3 domain and thus are not shown).

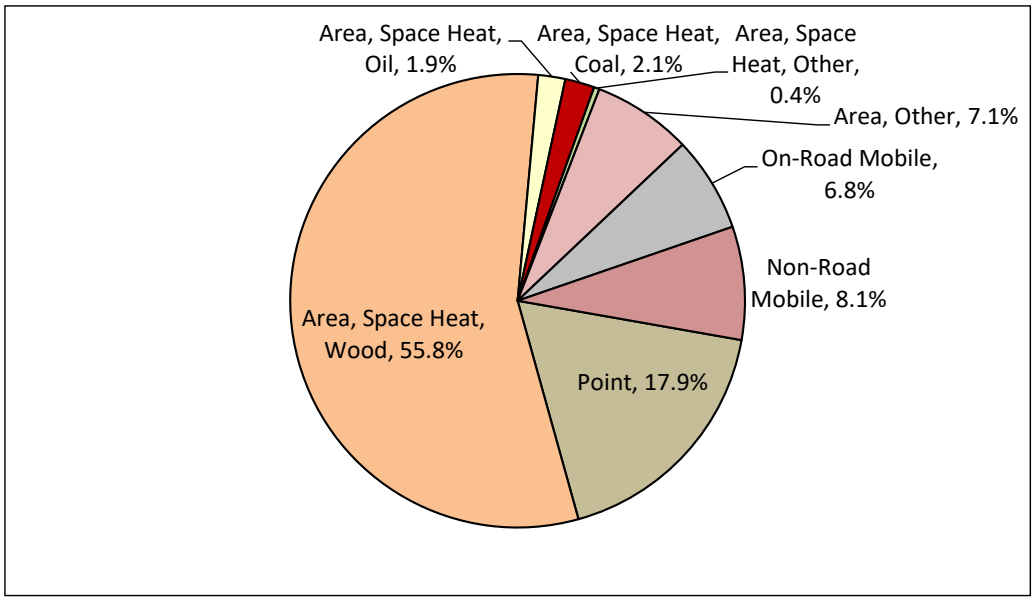

Figure 7.6-8. 2019 Baseline Episodic Nonattainment Area Emissions, Relative $PM_{2.5}$ Contributions (%)

As seen in Figure 7.6-8, space heating dominates episodic emissions of $PM_{2.5}$, representing roughly 59% of total $PM_{2.5}$ emitted within the nonattainment area. As noted above, wood-burning alone contributes over 60% to total $PM_{2.5}$. Point sources and on-road vehicles comprise 28% and 6% of total $PM_{2.5}$, respectively. All other area sources and non-road mobile sources combined encompass under 7%.

As shown in Figure 7.6-9 through Figure 7.6-12, the predominant source category for each gaseous precursor pollutant varies. Emissions of SO_2 largely come from point sources and secondarily from oil-burning heating devices. Point sources are the major contributors of episodic NO_x, while wood-burning space heating is the largest source of VOC and NH_3.

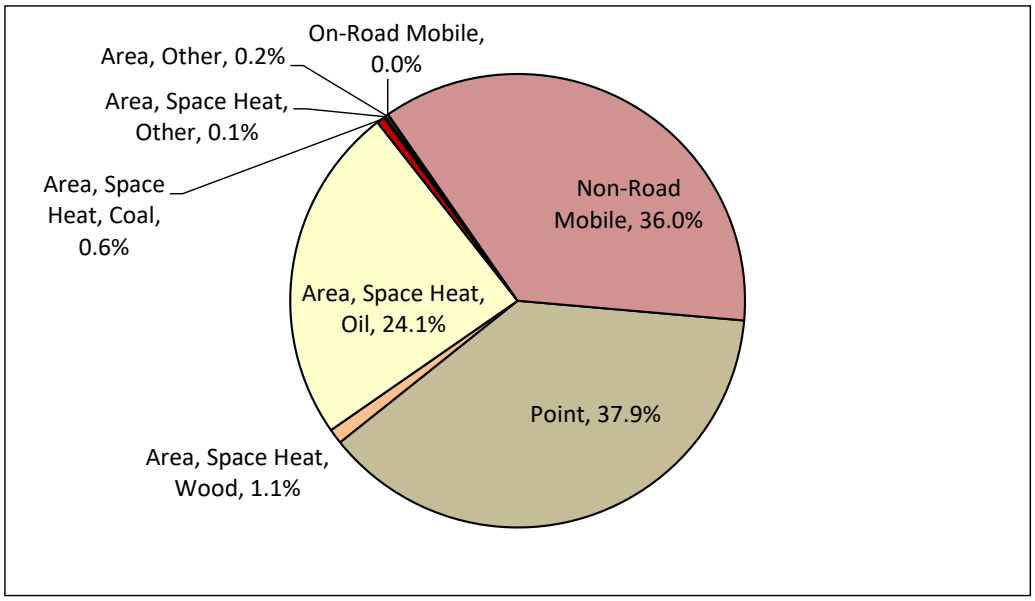

Figure 7.6-9. 2019 Baseline Episodic Nonattainment Area Emissions, Relative SO_2 Contributions (%)

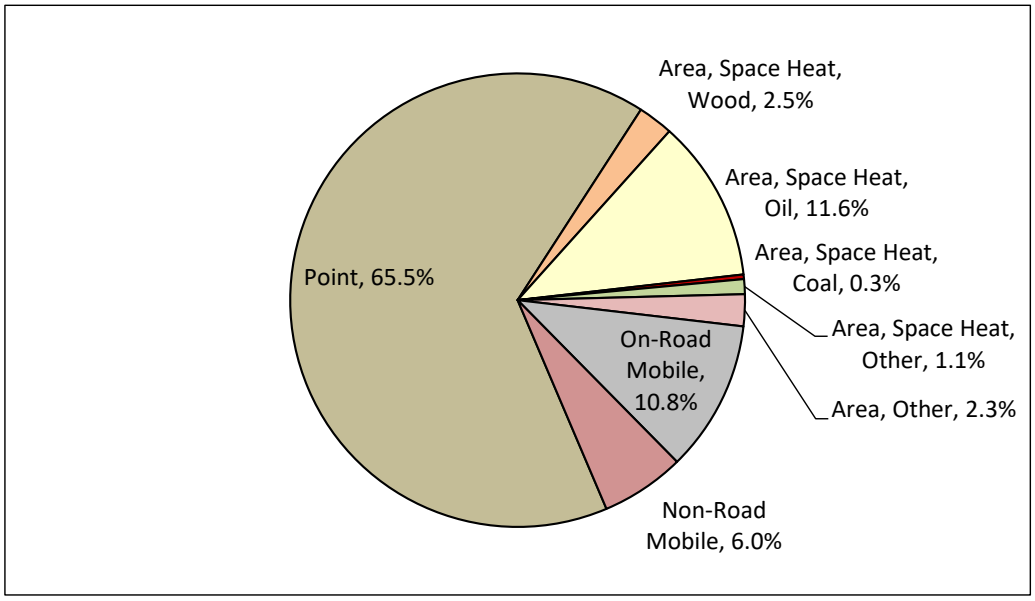

Figure 7.6-10. 2019 Baseline Episodic Nonattainment Area Emissions, Relative NO_x Contributions (%)

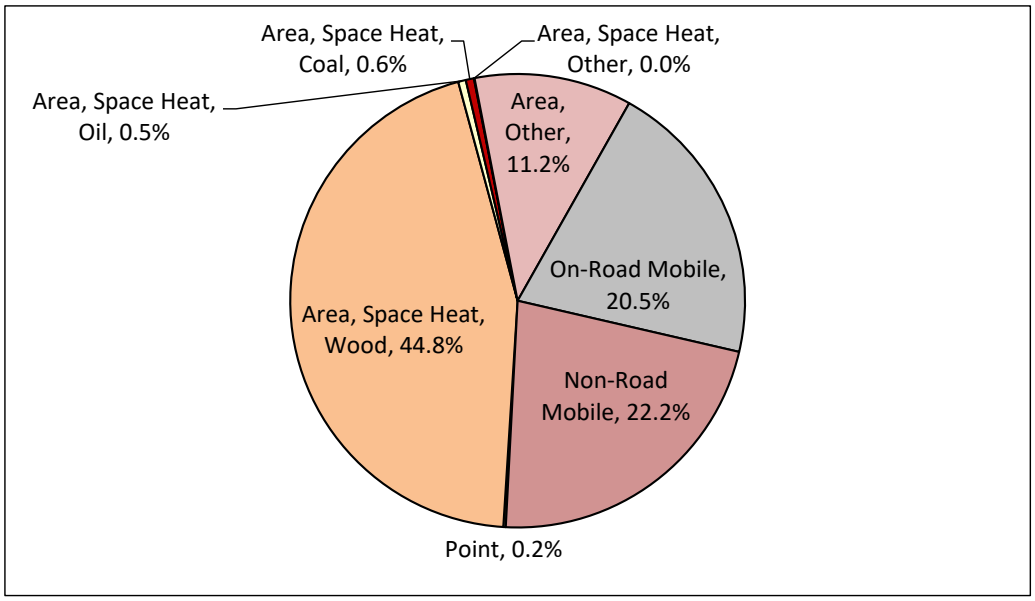

Figure 7.6-11. 2019 Baseline Episodic Nonattainment Area Emissions, Relative VOC Contributions (%)

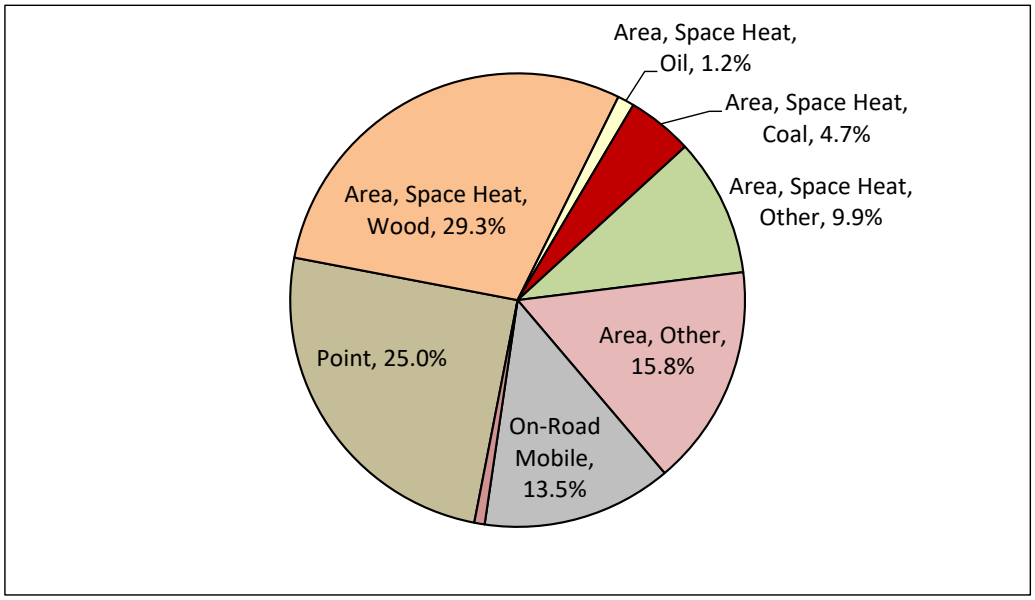

Figure 7.6-12. 2019 Baseline Episodic Nonattainment Area Emissions, Relative NH_3 Contributions (%)

Comparison to 2019 Serious SIP Inventory – Functionally, the 2019 Baseline inventory for this 5% is equivalent to the 2019 Control inventory developed under the Serious SIP in that they both reflect estimates of source activity in 2019 coupled with emission reductions from control measures adopted and implemented through the end of 2018. However, as explained earlier in Section 7.6.6.1, updated data collected between the development of the Serious SIP and this 2020 Amendment to the Serious SIP resulted in differences in emissions between the two 2019 inventories.

Table 7.6-8 compares emissions by source sector and pollutant (over the entire modeling domain) as well at the percentage difference in 2019 emissions under the 2020 Amendment to the Serious SIP relative to the Serious SIP. As shown in Table 7.6-8, the key changes in the 2020 SIP Amendment's 2019 inventory include: 1) lower point source emissions; 2) slightly lower space heating $PM_{2.5}$ emissions; 3) higher on-road mobile source emissions (except for NOx); and 4) generally lower non-road mobile source emissions. Overall, 2019 emissions for direct PM2.5 and key precursor SO2, are 12% and 33% lower than estimated under the Serious SIP.

Table 7.6-8
Comparison of 2020 Amended SIP vs. Serious SIP 2019 Emissions (tons/day) by Source Sector

	2020 Amendment SIP Inventory Grid 3 Domain Emissions (tons/day)					*Serious SIP Inventory Grid 3 Domain Emissions (tons/day)*				
Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point Sources	0.59	10.36	5.87	0.03	0.073	0.84	10.76	7.32	0.09	0.020
Area, Space Heating	2.21	2.61	4.16	9.55	0.145	2.41	2.62	4.17	9.58	0.145
Area, Space Heat, Wood	2.05	0.45	0.17	9.31	0.096	2.24	0.45	0.16	9.34	0.096
Area, Space Heat, Oil	0.07	1.94	3.87	0.11	0.004	0.07	1.95	3.90	0.11	0.004
Area, Space Heat, Coal	0.08	0.06	0.10	0.12	0.016	0.09	0.06	0.11	0.12	0.016
Area, Space Heat, Other	0.01	0.17	0.02	0.01	0.029	0.01	0.17	0.02	0.01	0.029
Area, Other	0.24	0.38	0.03	2.25	0.050	0.21	0.25	0.02	2.44	0.050
On-Road Mobile	0.27	2.30	0.01	4.90	0.055	0.18	2.32	0.01	3.61	0.048
Non-Road Mobile	0.36	1.75	7.78	5.26	0.003	0.52	2.51	15.29	6.58	0.002
TOTALS	3.67	17.40	17.85	22.00	0.325	4.16	18.46	26.81	22.30	0.265

	Percentage Difference, 2020 Amendment SIP vs. Serious SIP Emissions				
Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point Sources	-30%	-4%	-20%	-63%	+271 %
Area, Space Heating	-8%	-0%	-0%	-0%	-0%
Area, Space Heat, Wood	-8%	-0%	+10%	-0%	-0%
Area, Space Heat, Oil	-6%	-1%	-1%	-1%	+0%
Area, Space Heat, Coal	-11%	-1%	-4%	-1%	-1%
Area, Space Heat, Other	-4%	+0%	+2%	+0%	+0%
Area, Other	+16%	+53%	+85%	-8%	+0%
On-Road Mobile	+51%	-1%	+13%	+36%	+14%
Non-Road Mobile	-31%	-30%	-49%	-20%	+34%
TOTALS	-12%	-6%	-33%	-1%	+23%

These changes in emissions are consistent with the use of updated data for these sources sectors as summarized earlier in Section 7.6.6.1. In particular, the general decrease in point source emissions was the result of lower actual 2019 fuel usage for several facilities that projected from 2013 to 2019 under the Serious SIP based on forecasted population/housing growth. The slight decrease in space heating $PM_{2.5}$ emissions resulted from the use of a more granular approach to calculating emission benefits from the Borough's Wood Stove Change Out Program under the 2020 Amendment SIP (for

consistency with Borough reporting under Targeted Airshed Grants). The changes in on-road emissions are the result of the use of updated DMV registrations to characterize vehicle populations, mixes of vehicle types and age distributions. The decrease in non-road emissions for most pollutants was generally driven by updated data reflecting that aircraft are operated less during winter months than other times of the year. Finally, differences between the 2019 inventories were also affected by using updated long-term population/housing growth forecast data under the 2020 Amendment SIP that are discussed further in Section 7.6.7.1

7.6.7. 2020 Amendment Plan Projected Baseline Inventories

Projected Baseline inventories for applicable calendar years beyond the 2019 Baseline were not based on historically collected source activity data, but were projected forward to those years based on forecasted source activity growth coupled with changes in emission factors due to already adopted federal, State, and local control measures that existed prior to the development of this 2020 Amendment to the Serious SIP. As noted earlier, effects of adopted controls within the project baseline inventories reflect measures and data collection-based emission benefits accumulated through calendar year 2018 for consistency with the earlier Serious SIP, which was submitted to EPA in December 2019. In inventory development, the effects of controls are included up to the year prior to the inventory projection year of interest. In this case, the 2019 Baseline inventory includes emission reductions from adopted control measures and data collected through the end of calendar year 2018.

Control or attainment analysis/demonstration inventories then include additional emission reductions from measures to be implemented under this 2020 Amendment to the Serious SIP or from on-going control programs for which emission benefits continued to accumulate after the end of calendar year 2018 (the "anchor point" to the Serious SIP). Control inventories are discussed later in Section 7.6.8.

7.6.7.1 Emissions Projection Methodology

Growth Factors – Levels of projected source activity growth can vary depending upon the type of source category. A series of growth factors were assembled from several sources for use in forecasting the activity component of 2019 baseline emissions forward to 2024 and later years. Table 7.6-9 below summarizes the growth rates applied to project activity by source sector and the sources or assumptions upon which they were based. (Note: SE FB=Southeast Fairbanks, Yuk-K=Yokon-Koyukuk, Eielsn=Eielson AFB, Wainwrt=Fort Wainwright.) Highlighted sectors in Table 7.6-9 indicate where growth rates have been updated relative to those used in the Serious SIP based on more recent county-level population forecasts from the Alaska Department of Labor and Workforce discussed below.

Table 7.6-9
Summary of Growth Rates Applied in Projected Baseline Inventories

Source Type/Group	Growth Rate Source/Assumptions	Annual Growth Rate (% per year)		
		2013-2019	2019-2024	2024-2035
Point	Population growth rates from ADOT/Kittelson socio-economic forecasts for 2045 MTP (nonattainment area avg.)	0.9%	1.6%o	0.6%o
Area, Space Heating	Housing Unit growth rates from ADOT/Kittelson socio-economic forecasts for 2045 MTP (by grid cell)	0.9% domain average	1.7% domain average	1.7% domain average
Area, Other	Employment growth rates from ADOT/Kittelson socio-economic forecasts for 2045 MTP (nonattainment area avg.)	1.2%	1.4%	1.7%
Mobile, On-Road	Population growth rates from ADOT/Kittelson socio-economic forecasts for 2045 MTP (nonattainment area avg.) Population growth rates for other counties in modeling domain from county-level forecasts developed by Alaska Department of Labor and Workforce Development	FNSB: 0.9% Denali: -0.2% SE FB: -0.6% Ykn-K: -1.5%	FNSB: 1.6% Denali: 0.4% SE FB: 0.1% Ykn-K: -0.8%	FNSB: 0.6% Denali: 0.4% SE FB: 0.1% Ykn-K: -0.8%
Mobile, Non-Road Equip.	Population growth rates from ADOT/Kittelson socio-economic forecasts for 2045 MTP for FNSB Population growth rates for other counties in modeling domain from county-level forecasts developed by Alaska Department of Labor and Workforce Development	FNSB: 0.9% Denali: -0.2% SE FB: 0.1% Ykn-K: -1.0%	FNSB: 1.6% Denali: 0.4% SE FB: 0.1% Ykn-K: -0.8%	FNSB: 0.6% Denali: 0.4% SE FB: 0.1% Ykn-K: -0.8%
Mobile, Rail	Assumed held constant at 2013 levels, based on discussions with local rail and airport personnel	Zero	Zero	Zero
Mobile, Aircraft	Assumed constant at 2013 levels for Fairbanks International Base-specific forecasts provided by Eielson and Ft. Wainwright	FAI: 1.2% Eielsn: 16%[a] Wainwrt: 0%	FAI: 1.2% Eielsn: 11% [b] Wainwrt: 0%	FAI: 1.2% Eilsn: 0% [b] Wainwrt: 0%

[a] Reflects anomalously low Eielson airfield activity in 2013, coupled with 2019 activity estimated from annual average of recorded 2015-2018 flights at Eielson.
[b] Reflects F-35 fighter jet squadron deployment starting in 2020 and phasing in through 2022.

Growth factors were developed by individual calendar year from 2019 through 2035 as part of the 2020 Amendment SIP development process. Annualized growth rates are shown in Table 7.6-9 for three key periods: 2013-2019, 2019-2024 and 2024-2035. As explained earlier in Section 7.6.6, actual 2019 activity was used for certain sources sectors where available (e.g., point and on-road mobile source sources). Activity for other sectors were projected from 2013 to 2019 using the 2013-2019 growth rates. Separate growth rates for 2019-2024 vs. 2024-2035 are also included in Table 7.6-9 since the modeled attainment year is 2024 (as discussed in detail later in Section 7.8) and to delineate the higher growth from 2019-2024 for certain sectors related largely to the F-35 jet squadron deployment at Eielson.

The Alaska Department of Transportation and Public Facilities (ADOT)/Kittelson forecasts[24] listed for a number of sectors in Error! Reference source not found. **were**

[24] Mike Aronson and Anias Malinge, Kittelson & Associates memorandum to ADOT&PF, November 22, 2017.

developed to support the 2045 MTP. They represent the latest projects of population, housing unit and employment growth across the Fairbanks North Star Borough. Most importantly, they include projected population growth associated with the F-35 deployment at Eielson slated to begin in 2019 (with airfield activity increasing starting in 2020). They were developed by traffic analysis zone (TAZ) and allocated to the 1.3 km modeling grid cells.

The ADOT/Kittelson socio-economic forecasts were only available within the Fairbanks North Star Borough. As noted in Error! Reference source not found.**, county-level population forecasts published in May 2020 from the Alaska Department of Labor and Workforce Development[25] (ADLWD) were utilized to represent growth for mobile sources (except rail and aircraft). The Serious SIP used earlier ALDWD forecasts from June 1016**.

Rail activity was assumed to be constant at 2013 levels. Aircraft activity growth rates (i.e., changes in landing and takeoff (LTO) cycles) were airfield specific. Fairbanks International Airport (FAI) activity was projected to increase at a constant rate of 1.2% per year from 2013 levels based on the long-term growth rate in the FAI Master Plan.[26] For the military bases, airfield-specific growth projections by aircraft type were provided by Eielson and Fort Wainwright representatives. Fort Wainwright anticipated no long-term growth. As indicated by footnotes in Error! Reference source not found.**, Eielson's significant increase in aircraft flights relative to 2013 was the result of two factors:**

1. ***Anomalously Low 2013 Activity* – A review of historical annual flight data collected by the Federal Aviation Administration (FAA)[27] from 2010 through 2018 indicated that airfield LTOs at Eielson in 2013 were well below levels recorded in other surrounding years. Annual flight counts at Eielson averaged from 2015-2018 were found to be 145% higher than 2013 flights and applied in projecting Eielson activity from 2013 to 2019 (16% annualized growth), given that flights in 2013 were anomalously low.**

2. ***Increase from F-35 Fighter Jet Activity* – F-35 flights are scheduled to begin in 2020 and increase through 2022, then remain constant in 2023 and later years. The new F-35 operations are projected to increase total flights at Eielson by 71% from 2019 through 2024 (14% annualized growth).**

The historical FAA flight data were also reviewed for the other two airfields, Fairbanks International and Fort Wainwright. Their 2013 flights were found to be within 10% of the surrounding six-year averages. Thus no "anomalous year" adjustments were applied for activity at these airfields in projecting from their 2013 levels.

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[25] http://live.laborstats.alaska.gov/pop/projections.cfm, as of May 2020.

[26] "FAI Master Plan Project, Chapter 3 Aviation Forecasts," prepared by PDC Inc. Engineers for the Alaska Department of Transportation and Public Facilities, December 2014 (Final).

[27] Federal Aviation Administration, Traffic Flow Management System Counts, downloaded on September 12, 2019 from https://aspm.faa.gov/tfms/sys/Airport.asp.

Existing (Pre-2019) Controls – Effects of emission controls from adopted control programs (that reduce unit emission factors for specific source categories in future years) were also accounted for in the projected baseline inventories. As noted earlier, only those control programs that reflect on-going emission reductions or were adopted under the Moderate and Serious SIPs for which data-driven benefits were determined through 2018 and were included in the Projected Baseline inventories. These key control programs[28] and how they were modeled are listed below:

- ***On-Road Vehicles* – Effects of the on-going federal Motor Vehicle Control Program and Tier 3 fuel standards, coupled with Alaska Ultra Low Sulfur Diesel standards were accounted for within EPA's MOVES2014b model.**

- ***Non-Road Vehicles and Equipment* – Effect of federal fuel and Alaska ULSD programs for non-road fuel were modeled using EPA's MOVES2014b model.**

- ***Wood Stove Change Out Program (2013-2018)* – Data collected by the Fairbanks North Star Borough on closed/completed transactions under the on-going Wood Stove Change Out (WSCO) Program from 2013 through 2018 were analyzed to develop estimates of emission reduction per transaction and summed over this period to account for WSCO reductions beyond the 2013 center point of the 2011-2015 Home Heating device and fuel usage survey data.**

- ***Solid Fuel Burning Curtailment Program (2018)* – The Fairbanks Borough adopted and operated an episodic Solid Fuel Burning Appliance and Curtailment Program since winter 2015-2016. It was treated as a new measure within the Control inventories under the Moderate SIP. Under this 2020 Amendment to the Serious SIP its benefits, reflecting the design of the program and its operation as of the end of 2018, are now accounted for as existing controls within the Projected Baseline inventories. As of the end of 2018, the Curtailment Program operated with two alert stage levels. Stage 1 (35 µg/m^3) and Stage 2 (55 µg/m^3) required cessation of burning from specific types of solid fuel devices as follows:**

    - **Stage 1 - Burning was permitted in all EPA-certified SFBAs, EPA Phase II qualified hydronic heaters with emission ratings of 2.5 g/hour or less, masonry heaters, pellet-fueled appliances cook stoves and fireplaces. Burning was prohibited from all other devices including non-EPA certified devices and waste oil devices.**
    - **Stage 2 - Burning was prohibited in all SFBAs, masonry heaters, pellet-fueled appliances, cook stoves, fireplaces and waste oil devices.**

  Consistent with the Serious SIP, the Curtailment Program as of the end of 2018 had an estimated compliance rate of 30%.

[28] Effects of other state and local control measures listed in the Moderate SIP for which benefits were quantified were implicitly included in the "pre-control" Projected Baseline emissions.

Other Adjustments – Beyond the application of activity growth factors and accounting for effects of existing controls from the Moderate and Serious SIPs, three other adjustments were applied in developing Projected Baseline inventories and are summarized separately below.

Wood vs. Oil Cross-Price Elasticity **– A postcard (rather than telephone) survey was conducted in 2016 to assess whether large drops in heating oil prices from 2013 to 2015 had any impact on wood use. Unlike the earlier telephone-based surveys under which a random sample was drawn from all residents in the nonattainment area, the 2016 Postcard survey targeted household respondents who had participated in the 2014 and 2015 HH surveys. Use of a postcard survey instrument enabled respondents to more thoughtfully collect and estimate wood and heating oil usage data for winter 2015-2016 space heating that could be directly compared to similar data for the same set of households as sampled in the earlier 2014 and 2015 surveys. An analysis directed by DEC[29] found that winter season residential wood use dropped 30% on average in the 2016 survey for the same set of households sampled in the 2014 and 2015 surveys, and that most of this drop could not be explained by differences in heating demand due to year-to-year variations in winter temperatures.**

DEC's Staff Economist then coordinated a study by University of Alaska Fairbanks[30] that evaluated the 2016 Postcard data to determine if a cross-price elasticity could be quantified between wood use and heating oil use and prices in Fairbanks. That economic study found a median cross-price elasticity between wood and heating oil of -0.318, meaning wood use drops by 0.318% for every 1% decrease in the price of heating oil. This wood vs. cross-price elasticity was then used to estimate changes in wood vs. oil use in projected baseline inventories relative to the difference between the forecasted oil price in the projection year vs. the 2013 Baseline.

Historical heating oil prices in Fairbanks were available through calendar year 2019 from the Fairbanks Community Research Quarterly published by the Fairbanks Borough Planning Department. Heating oil prices for 2020 and later projected baselines were forecasted from the actual 2019 price based on forecasted changes in heating oil prices for the Pacific Region between 2018 and the projected baseline year published by the U.S. Energy Information Administration (EIA) in their 2020 Annual Energy Outlook (AEO).[31]

For the 2019 Baseline, the actual heating oil price in Fairbanks was $2.90 per gallon and the 2013 price (averaged over the 2011-2015 period corresponding to the five-year HH survey period) was $3.56 per gallon. For the Projected 2024 Baseline, a forecasted heating

[29] T. Carlson, M. Lombardo, Sierra Research, R. Crawford, Rincon Ranch Consulting memorandum to Cindy Heil, Alaska Department of Environmental Conservation, January 17, 2017.

[30] "Estimating FNSB Home Heating Elasticities of Demand using the Proportionally-Calibrated Almost Idea Demand System (PCAIDS) Model: Postcard Data Analysis," prepared by the Alaska Department of Environmental Conservation in collaboration with the University of Alaska Fairbanks Master of Science Program in Resource and Applied Economics, December 10, 2018.

[31] The Serious SIP was based on historical data through 2017 and EIA's then-current 2018 AEO.

oil price of $3.06 per gallon was estimated based scaling of the 2020 AEO Reference forecast.

Projected changes in wood use from 2013 to 2019 and 2019 to 2024 of -5.9% and +1.8%, respectively were calculated based on these oil prices and the cross-price elasticity of -0.318 as follows:

$$\textit{Wood Use Change}_{2013\text{-}2019} = -0.318 \times (1 - \$2.90/\$3.56) = -5.9\%$$
$$\textit{Wood Use Change}_{2019\text{-}2024} = -0.318 \times (1 - \$3.06/\$2.90) = +1.8\%$$

Turnover of Uncertified Devices **– Under the Moderate SIP it was estimated that turnover or replacement of uncertified wood burning devices with new EPA-certified devices occurred both through and separate from the WSCO Program. That estimate was based on HH survey data that was only available through the 2011 survey. Since the WSCO program began in July 2010, there was little overlap between trends established from the HH surveys (dating back to 2006 and extrapolated beyond 2011) and the available WSCO Program change outs/transactions. With the data available at the time of the Moderate SIP development, it was then estimated that there was a downward trend in uncertified wood devices (reflecting replacement with EPA-certified devices) that was separate and distinct from that attributed to the WSCO Program.**

Under the earlier Serious SIP and this 2020 Amendment to the Serious SIP, additional years of HH survey data (2012-2015) and WSCO Program data (through calendar year 2018) were analyzed. Over the broader 7½-year period of overlap between the HH surveys and WSCO Program activity data now available, it was found that very little uncertified device turnover likely occurs outside the WSCO Program. What was termed "natural turnover" of uncertified devices estimated to occur outside of the WSCO Program under the Moderate SIP was found to be difficult to separately quantify based on comparisons of HH survey trends and WSCO Program activity and is likely negligible. Therefore no "natural turnover" of uncertified devices outside the WSCO Program was assumed for the Serious SIP Projected Baseline inventories. The downward trend in uncertified devices seen in the HH surveys through 2015 was attributed entirely to the on-going WSCO Program. The same assumption was applied under this 2020 Amendment to the Serious SIP.

Appendix III.D.7.6 contains further information on the calculations behind these other adjustments.

7.6.7.2 2024 Projected Baseline Emission Inventory

Using the projected activity growth factors, emission factors representing effects of existing source control programs and other adjustments to point sources and wood usage as summarized in the preceding sub-section, a projected baseline inventory was developed for 2024, the year determined by DEC as the modeled attainment year for the 2020 Amendment to the Serious SIP.

Table 7.6-10 presents a sector-level summary of the 2024 Projected Baseline modeling and planning inventories. Table 7.6-11 provides sector- and pollutant-specific comparisons of the relative changes in emissions between the 2019 Baseline and the 2024 Projected Baseline inventories (both modeling and planning versions).

Table 7.6-10
2024 Projected Baseline Episode Average Daily Emissions (tons/day) by Source Sector

	Modeling Inventory Grid 3 Domain Emissions (tons/day)					*Planning Inventory NA Area Emissions (tons/day)*				
Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point Sources	0.64	11.21	6.35	0.04	0.079	0.62	11.16	6.16	0.03	0.079
Area, Space Heating	2.48	2.87	4.53	10.52	0.156	2.14	2.43	4.20	8.60	0.132
Area, Space Heat, Wood	2.30	0.49	0.19	10.26	0.104	1.98	0.39	0.17	8.38	0.086
Area, Space Heat, Oil	0.07	2.13	4.21	0.12	0.004	0.07	1.82	3.91	0.10	0.004
Area, Space Heat, Coal	0.09	0.06	0.11	0.14	0.017	0.07	0.05	0.09	0.11	0.014
Area, Space Heat, Other	0.01	0.18	0.02	0.01	0.031	0.01	0.17	0.02	0.01	0.029
Area, Other	0.26	0.41	0.03	2.42	0.053	0.24	0.38	0.03	2.24	0.050
On-Road Mobile	0.20	1.67	0.01	4.45	0.058	0.16	1.25	0.01	3.55	0.043
Non-Road Mobile	0.36	1.79	8.88	4.60	0.003	0.24	1.02	5.59	3.64	0.002
TOTALS	3.93	17.95	19.80	22.02	0.350	3.40	16.24	15.98	18.06	0.306

Table 7.6-11
Relative Change (%) in Episode Average Daily Emissions (tons/day) by Source Sector, 2024 Projected Baseline vs. 2019 Baseline

	Modeling Inventory Change in Grid 3 Domain Emissions (%)					*Planning Inventory Change in NA Area Emissions (%)*				
Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point Sources	+8%	+8%	+8%	+8%	+8%	+8%	+8%	+8%	+8%	+8%
Area, Space Heating	+12%	+10%	+9%	+10%	+8%	+12%	+0%	+8%	+0%	+0%
Area, Space Heat, Wood	+12%	+10%	+9%	+10%	+8%	+12%	+0%	+8%	+0%	+0%
Area, Space Heat, Oil	+12%	+10%	+9%	+10%	+8%	+12%	+0%	+8%	+0%	+0%
Area, Space Heat, Coal	+12%	+10%	+9%	+10%	+8%	+12%	+0%	+8%	+0%	+0%
Area, Space Heat, Other	+12%	+10%	+9%	+10%	+8%	+12%	+0%	+8%	+0%	+0%
Area, Other	+7%	+7%	+7%	+7%	+7%	+7%	+7%	+7%	+7%	+7%
On-Road Mobile	-25%	-27%	-2%	-9%	+6%	-24%	-26%	-0%	-7%	+8%
Non-Road Mobile	-1%	+2%	+14%	-13%	+3%	-8%	+8%	+3%	-13%	+4%
TOTALS	+7%	+3%	+11%	+0%	+8%	+7%	+3%	+6%	-3%	+4%

As highlighted at the bottom of Table 7.6-11, total $PM_{2.5}$ emissions under the 2024 Projected Baseline are 7% higher across the nonattainment area than in 2019. This is largely driven by the population/employment growth rates used to project source activity for 2019 to 2024.

The gaseous pollutants show similar overall reductions, driven by factors that span several sectors including federal mobile source controls. The higher increase in SO_2 emissions is largely due to the change in aircraft flights at Eielson AFB between 2019 and 2024.

7.6.8. 2020 Amendment Plan 2024 Attainment Control Inventory

The second and final stage of estimating emissions in future years consisted of applying adjustments to the Projected Baseline inventories to reflect additional incremental effects of State and local control measures not included in those baselines that reflect emission reductions through the end of calendar year 2018. These final future year inventories are called the Control inventories. Based on calculation of Control inventories in calendar years 2020 through 2029, DEC estimated that additional (post-2019) emission reductions from adopted control measures would likely be sufficient to demonstrate attainment in the 2024 timeframe. As explained in Section 7.8, this was subsequently determined to be the case by running the 2024 Control inventory through the air quality model. Therefore, the remainder of this emission inventory chapter focuses on the 2024 Control inventory. Control inventories for other required years associated with 5% Per Year Reduction and Reasonable Further Progress/Quantitative Milestone requirements are discussed in Sections 7.9 and 7.10, respectively.

7.6.8.1 2024 Control Benefits Analysis

Emission benefits for control measures adopted under the earlier Serious SIP and this 2020 Amendment to the Serious SIP that take effect or continue to provide reduction in 2019 and later years beyond those reflected in the Moderate SIP were quantified for both on-going Borough programs and DEC-adopted regulations/measures.

Within the Borough's jurisdiction, this consists of the Wood Stove Change Out Program and the Oil-To-Gas Conversion Program. Under DEC authority, this includes the Solid-Fuel Burning Appliance Curtailment Program as well as a set of seven control measures adopted under the Serious SIP (and continued under the 2020 Amendment SIP) for which emission benefits were quantified and incorporated into the 2024 Control inventory. As discussed later in Section 7.7, DEC has adopted and is implementing additional measures beyond those for which emission benefits were quantified for attainment analysis and 2020 Amendment SIP progress/reduction requirements.

Emission benefit calculations from the two local programs are described below.

Borough Wood Stove Change Out & Oil-to-Gas Conversion Programs (2019 and later) – As noted earlier, since June 2010, the Borough has operated a program within the nonattainment area designed to provide incentives for the replacement of older, higher-polluting residential wood-burning devices with new cleaner devices, or removal of the old devices. The design of the Wood Stove Change Out (WSCO) Program has evolved over time, but these changes have generally consisted of both increasing the financial incentives as well as expanding the types of solid fuel burning appliances (SFBAs) or devices that are eligible to participate in the program.

Under its current design, the WSCO program provides financial incentives as follows:

REIMBURSEMENT OPTIONS

- ***Replace Other SFBA (including all cordwood stoves, all pellet stoves, all fireplaces, and all fireplace inserts) with an:***
  - ***appliance designed to use natural gas or propane (up to $10,000)****
  - ***appliance designed to use home heating oil (excluding waste/used oil), emergency power system (i.e. generator), hot water district heat, or electricity (up to $6,000)****
  - ***EPA Certified pellet burning appliance with an emissions rate less than or equal to 2.0 grams/hour (up to $5,000)***
  - ***EPA certified CATALYTIC SFBA with an emissions rating of 2.0 grams/hr or less, or if an EPA certified SFBA with an emissions rate of 2.5 grams/hour or greater and was manufactured prior to 1998 is replaced with another EPA certified SFBA, the emission rate of the new appliance must be 2.0 grams/hour or less AND 50% or less than the replaced appliance (up to $4,000). An old EPA-certified wood appliance manufactured during the year 1998 forward can only be replaced with an oil appliance or gas appliance or electric appliance or hot water district heat or a new EPA-certified pellet stove or an emergency power system.***
- ***Replace Hydronic heater with an:***
  - ***appliance designed to use natural gas, propane, hot water district heat, or electricity* (up to $14,000)***
  - ***appliance designed to use home heating oil* (excluding waste/used oil) (up to $12,000)***
  - ***EPA certified CATALYTIC wood stove or an EPA certified pellet stove with an emissions rating of 2.0 grams/hr or less, or an EPA phase II certified pellet burning hydronic heater with an emissions rating of 0.1 lbs/million BTU or less, or emergency power system (i.e. generator)* (up to $10,000)***
- ***Removal of a:***
  - ***SFBA -- $2,000 cash payment (includes all cordwood stoves, all pellet stoves, all fireplaces, and all fireplace inserts)****
  - ***hydronic heater -- $5,000 cash payment****
- ***Repair Catalytic converter or Other Emissions-Reducing Components (up to $750)***

****These options require a deed restriction.***

In addition, the Borough appropriated funding in 2020 for an additional Oil-To-Gas Conversion (OCG) Program designed to incentivize conversions in homes using heating oil to natural gas-fueled heating systems. Incentives offered under the OGC Program are as follows:

- **Conversion of an existing appliance using heating oil to an appliance using natural gas or propane, up to $2,500 for parts, labor, gas line, hookup fees, and other associated fees.**
- **Removal and replacement of an existing appliance using heating oil with an appliance using natural gas or propane, up to $7,500 for removal of old appliance, new appliance, parts, labor, gas line, hookup fees, and other associated fees.**

WSCO transaction data were obtained from the Borough through calendar year 2019. For each application under the program, the Borough records the following elements:

- **Applicant information (including address);**
- **Program/transaction type (replacement, removal, repair);**
- **Old device type (e.g., fireplace, wood stove, OWB, etc.);**
- **Old device certification (uncertified or EPA-certified);**
- **Old device model (and certified emission rate for certified devices);**
- **New device type (which can include conversion to heating oil or natural gas devices);**
- **New device model;**
- **New device certification (where applicable);**
- **New device emission rate (where applicable); and**
- **Application status (pending or closed/completed).**

Historically, participation in the WSCO Program has generally been limited by available funds and staffing, rather than resident participation and interest. Periods where pending applications are near zero have been rare, and the Borough has been proactive over the years in enhancing the program's features and incentive levels to continue to yield verifiable conversions to cleaner residential heating devices and fuels. To maximize the air quality benefit of the WSCO Program, applications are evaluated through a prioritization matrix, based on three parameters: air quality control zone (AQCZ), emission reductions, and burn frequency. Eligible structures or appliances must be located inside the AQCZ, which is further broken down into four sub-zones ranging from best to worst air quality. Zone designation is based on data gathered from 2008 to 2018 through FNSB's hot spot guidance program, which used vehicle-mounted low cost pDR monitors to gather daily data throughout the AQCZ from October through March. Emission reductions are based on the existing appliance, burn frequency, and the replacement option with larger emission reductions available for removing the SFBA and converting to a non-SFBA appliance; conversions are prioritized higher than SFBA to SFBA change outs.

With this backdrop, incremental benefits from the WSCO program beyond its reductions accounted for in the Serious SIP reflect change outs that occurred in calendar year 2019 and are forecasted in 2020 and later years. This also includes forecasted transactions starting in 2020 from the additional OGC Program. The forecasts were developed by the Borough and reflect the following key elements:

- ***Funding* – Includes funding from three awarded EPA Targeted Airshed Grants (TAGs) for 2016, 2017 and 2018, collectively providing $9.1 million for WSCO Program activity through calendar year 2024.**

- ***Staffing* – Reflects current Borough and certified community device installation/verification staffing, with no additional staffing increases.**

The State also anticipates receiving additional WSCO Program-related funding under the 2019-2020 TAG. Forecasts including this additional 2019-2020 TAG funding were also developed. However, since EPA has not yet awarded the 2019-202TAG application funds, change-outs from this additional 2019-2020 TAG funding were incorporated into the Control inventories and attainment analysis at this time.

Table 7.6-12
Actual (2019) and Forecasted Change-Outs Under Borough WSCO and OGC Programs **shows actual recorded change-outs in calendar year 2019 along with forecasted change-outs in 2020 and later years based on funding and staffing as noted above. Forecasted changeouts under both funding scenarios (2016-2018 TAG and 2016-2020 TAG funding), although as indicated above, Control inventory emission reduction estimates are based on 2016-2018 TAG funding only and thus likely reflect conservative (understated) projections of emission reductions expected over this period from the WSCO Program. Both scenarios also reflect separate Borough funding for the OGC Program; change-outs under the OGC Program as denoted under the "FNSB O>G" change-out type in Table 7.6-12**
Actual (2019) and Forecasted Change-Outs Under Borough WSCO and OGC Programs**.**

Table 7.6-12
Actual (2019) and Forecasted Change-Outs Under Borough WSCO and OGC Programs

Change-Out	Actual Change-Outs	Forecasted Change-Outs by Calendar Year 2016-2018 TAG Funding					Forecasted Change-Outs by Calendar Year 2016-2018 and 2019-2020 TAG Funding					
Type	2019	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024	2025
SFBA-N>Y	16	15	10	0	0	0	15	30	45	70	88	100
SFBA-Y>Y	1	0	0	0	0	0	0	0	0	0	0	0
Conv-All	146	236	239	190	103	35	236	295	310	292	276	273
FNSB O>G	0	50	50	17	0	0	50	50	17	0	0	0
Removal	11	19	18	10	6	2	19	28	30	37	42	46
Repair	1	0	0	0	0	0	0	0	1	2	2	2
Bounty	0	0	0	0	0	0	0	10	21	33	42	48
NOASH Red	0	0	0	0	0	0	0	4	9	15	19	21
TOTALS	175	320	317	217	109	37	320	417	433	449	469	490

Each of the change-out types abbreviated in Table 7.6-12
Actual (2019) and Forecasted Change-Outs Under Borough WSCO and OGC Programs **are defined as follows:**

- **SFBA-N>Y – Replacement of uncertified SFBA with EPA-certified SFBA**
- **SFBA-Y>Y – Replacement of EPA-certified SFBA with cleaner (<2 g/hr) EPA-certified SFBA**
- **Conv-All – Conversion of SFBA to heating oil, natural gas or emergency power/electric device**
- **FNSB O>G – Conversion of heating oil to natural gas device (under OGC Program)**
- **Removal – Removal of SFBA with no replacement**
- **Bounty – Non-deeded removal from anywhere in nonattainment area**

- **Repair – Repair of existing SFBA**
- **NOASH Red – Replace/repair/upgrade of SFBAs in NOASH (No Other Adequate Source of Heat) households.**

As highlighted in gray in Table 7.6-12
Actual (2019) and Forecasted Change-Outs Under Borough WSCO and OGC Programs**, change-outs of EPA-certified to cleaner certified SFBA's have been de-prioritized and no further transactions of this type (SFBA,Y>Y) are projected in 2020 and later years under either funding scenario. In addition, the Bounty and NOASH Reduction change-outs were added to the 2019-2020 TAG application and are forecasted to begin in 2021 after the anticipated award of funding for that application.**

A Bounty transaction would consist of non-deeded removal of an existing SFBA with eligibility throughout the nonattainment area. Currently, deeded SFBA removals are only allowed within the Air Quality Control Zone (AQCZ) portions of the nonattainment area. Lower reimbursements would be offered for Bounty transactions (relative to deeded Removals) to ensure deeded Removals are still incentivized. A NOASH Reduction change-out targets reductions in solid-fuel emissions from households that have no other adequate heat source (NOASH), and are currently granted a waiver from the Curtailment Program, when approved as a NOASH household. The NOASH Reduction element is intended to incentivize shifts from solid fuel burning in these households to cleaner fuel, assumed to be heating oil.

It is noted that the forecasts in 7.6-29 were developed based on historical data (2013-2019), funding and staffing availability and the prioritization matrix described earlier. These are "best estimate" projections[32] and reflect insights the Borough has gained since early 2018 in tracking and providing quarterly reporting summaries to EPA for the existing awarded TAGs.

For each completed transaction, $PM_{2.5}$ and SO_2 emission benefits were calculated using the information listed above. Emission factors (in lb/mmBTU) by device/technology/certification status used in the baseline inventory were used to represent emissions for old devices being replaced, removed or repaired.

For wood-to-wood device replacements, emission factors of new devices were estimated from regression-based translations of certification emission rates (gram/hr) to emission factors (lb/mmBTU) developed from EPA certified wood burning device database. For solid fuel to oil/natural gas conversion replacements, inventory-based heating oil or natural gas emission factors were applied to represent "after change out" emissions from the new device.

[32] **These projections were developed in mid-March 2020 before the effects and extent of the COVID-19 pandemic were known. Since that time, the Borough has continued to track and process applications, despite some limitations caused by the pandemic. Although near-term shortfalls may occur depending on the length of these limitations, the Borough is proactively coordinating and executing additional public awareness efforts around the WSCO Program status to maximize its ability to catch-up and achieve these projections in the longer term.**

For device removal transactions, it was assumed that the heating energy associated with removing the old wood device would be replaced with equivalent heating energy of a heating oil device. For device repair transactions, an average 10% emission reduction was assumed. (There were only a modest number of repair transactions, but some included repair of the catalyst and chimney which could provide measurable reductions or efficiency improvements).

In addition, for all device replacement or removal transactions effects of differences in old vs. new (or shifted) device heating efficiency were also accounted for.

Finally, the methodology used to calculate before and after change-out household emissions from replacement, removal or repair was enhanced from that used under the Serious SIP, primarily to ensure consistency with a more granular, episodic-based approach used by the Borough in calculating WSCO emission benefits under its quarterly TAG reporting. The Serious SIP used estimates of household energy use that were averaged over the entire winter nonattainment season. Under this 2020 Amendment to the Serious SIP, the before and after energy use estimates were extracted directly from episodic space heating inventories at the device/SCC level. Not surprisingly, the emission reductions driven by these episodic and granular, device-specific energy use estimates were on average, larger than those estimated under the Serious SIP.

The per-transaction emission reductions (calculated on a tons per episode day basis) were then tabulated by calendar year (based on close out date). Table 7.6-13 presents a summary of the number and types of completed/verified WSCO Program and OGC transactions in calendar years 2019 through 2023 and their calculated $PM_{2.5}$ and SO_2 emission reductions (in tons/episode day) based on the methods described above. These transactions reflect reductions through the end of 2023 and thus represent effects of the WSCO/OGC Programs in the 2024 Control inventory.

Table 7.6-13
WSCO and OGC Program Transactions and Emission Reductions, 2019-2023

Change-Out Type	Description	Change-Out Transactions	Reductions (tons/episode day)	
			$PM_{2.5}$	SO_2
SFBA-N>Y	SFBA replacement, uncertified to certified	41	0.0126	0.0001
SFBA-Y>Y	SFBA replacement certified to 2 gram/hour certified	1	0.0001	0.0000
Conv-All	Conversion of SFBA to heating oil, natural gas or electric device	914	0.6551	0.0117
FNSB O>G	Conversion of heating oil to natural gas device (OGC Program)	117	0.0000	0.0000
Removal	SFBA Removal	64	0.0262	-0.0035
Repair	Repair of Existing SFBA	1	0.0000	0.0000
Bounty	Non-deeded SFBA removal anywhere in nonattainment area (2019-2020 TAG only)	0[a]	0[a]	0[a]

NOASH Red	**Replace SFBAs in NOASH households (2019-2020 TAG Only)**	**0 [a]**	**0 [a]**	**0 [a]**
TOTALS		**1,138**	**0.6941**	**0.0083**

As highlighted at the bottom of Table 7.6-13, direct $PM_{2.5}$ reductions from the WSCO/OGC programs in 2019 through 2023 totaled nearly 0.7 tons/episode day. SO_2 emission reductions are much smaller due to device removals and conversions to heating oil, which has higher per unit energy sulfur content than wood.

Curtailment Program – In 2019, the Solid-Fuel Burning Appliance Curtailment Program consisted of a two alert stage program at 25 µg/m^3 (Stage 1) and 35 µg/m^3 (Stage 2). Under Stage 1, only certified solid-fuel devices can operate. Under Stage 2, no solid fuel devices can operate except those granter NOASH (No Other Adequate Source of Heat) waivers within the Fairbanks and North Pole Air Quality Control Zones (AQCZs) inside the nonattainment area

On January 8, 2020, DEC increased the alert stringencies of the Curtailment Program, dropping the alert stages to 20 µg/m^3 and 30 µg/m^3, respectively. In addition, DEC plans to utilize expected funding from the 2019-2020 TAG toward several Dynamic Message Signs, an infrared camera and expanded staffing to increase compliance. As a result, DEC estimates the Curtailment Program compliance rate to increase from 30% in 2019 to 45% by 2024.

Benefits of the "revised" Curtailment Program in 2024 were calculated in a manner similar to that applied under the Serious SIP. Reduction fractions were applied to Projected Baseline space heating emissions by device/technology type/fuel type for the inventory strata listed earlier in Table 7.6-5 (Section 7.6.6.3). These reduction fractions accounted for the fraction of devices (by stratum) operating under each curtailment stage, given the estimated compliance rate and the NOASH households fraction. The NOASH fraction within the nonattainment area was estimated from the 2011-2015 HH survey data at 4%. This fraction is higher than the annual NOASH waiver applications received by DEC. The higher NOASH rate was assumed for consistency with other elements of the emission inventory, which has a conservative or understated impact on resulting emission benefits from the Curtailment Program. In addition to accounting for emission reductions associated with curtailment of solid fuel burning devices, the analysis also accounts for emissions from "shifted" energy use under each curtailment stage to heating oil and addresses efficiency differences between the solid fuel and heating oil devices.

Finally, the emission reductions are discounted to account for the fraction of households within the nonattainment area that are outside the Fairbanks and North Pole AQCZs within which the Curtailment Program applies. The fraction of nonattainment area emissions occurring within the nonattainment area, but outside these AQCZ was estimated at 12.4% and was determined from a GIS-based analysis of block-level occupied household data from the 2010 Census.

Table 7.6-14
Incremental Curtailment Program Emission Reductions (2024 vs. 2019) **summarizes the resulting incremental emission benefits associated with revisions to the Curtailment Program between 2019 and 2024. It is noted that in applying the benefits of the Curtailment Program within the downstream air quality modeling, benefits are separately calculated at each alert stage by SCC code. The benefits shown in Table 7.6-14** Incremental Curtailment Program Emission Reductions (2024 vs. 2019) **are higher than the average across all modeling episode days, some of which do not exceed the alert thresholds**.

Table 7.6-14
Incremental Curtailment Program Emission Reductions (2024 vs. 2019)

Program State	Reductions (tons/day)	
	$PM_{2.5}$	SO_2
2024 Curtailment Program, 20 & 30 µg/m^3 Alert Stages, 45% Compliance	0.993	-0.171
2019 Curtailment Program, 25 & 35 µg/m^3 Alert Stages, 30% Compliance	0.642	-0.113
Incremental Reductions: 2024 vs. 2019 Program	0.351	-0.058

State-Adopted Space Heating Measures (post-2019) – In addition to these local (WSCO/OGC) and state (Curtailment) programs, DEC adopted a series of additional control measures targeting space heating sources under the Serious SIP that are being implemented and take effect after 2019. Episodic emission benefits for seven of them were quantified and included within the 2024 Control inventory. These control measures are summarized in Table 7.6-15
Post-2019 State-Adopted Space Heating Control Measures and Implementation Schedules**. Consistent with application of control benefits only when they apply for an entire calendar year, the starting year listed refers to January 1 of the year following the scheduled implementation date. The 2024 Phase-In Rate column reflects the combined penetration/compliance rate projected by calendar year 2024.**

Section III.D.7.7 of the SIP provide more thorough descriptions of each control measure. And Appendix III.D.7.6 contains a detailed analysis spreadsheet that lists all data sources and assumptions and provides documented step-by-step calculation of the $PM_{2.5}$ and SO_2 emission benefits from each of these measures. (These calculations are in measure-specific sheets with the names of the measure abbreviation code listed in Table 7.6-15
Post-2019 State-Adopted Space Heating Control Measures and Implementation Schedules**.) Calendar year-specific sheets labeled "SCCRedFacs*YYYY*" where *YYYY* is the calendar year contain calculations that "package" the combinations of all implemented space heating control measures into combined emission reduction estimates and account for overlapping effects of individual measures that target the same "Before Measure" sources.**

Table 7.6-15
Post-2019 State-Adopted Space Heating Control Measures and Implementation Schedules

Measure Abbrev	Measure Description	Starting Year	2024 Phase-In Rate
STF-12	Shift #2 to #1 Oil	2023	100%
STF-13	Commercial Dry Wood	2022	75%

STF-17	**Wood Device Removal**	**2024**	**15%**
BACM-R8	**Wood Emission Rates**	**2020**	**100%**
BACM-48	**Remove Coal Devices**	**2024**	**25%**
STF-22	**No Primary Wood Heat**	**2020**	**80%/100%**
STF-23	**NOASH/Exemption Requirements**	**2020**	**70%**
NGE	***Natural Gas Expansion***	***2020***	***0%***

Natural gas expansion (NGE) is listed in shaded italics at the bottom of Table 7.6-15 Post-2019 State-Adopted Space Heating Control Measures and Implementation Schedules **and refers to planned expansion of the limited existing natural gas infrastructure by the Interior Gas Utility (IGU) to provide availability and incentivize conversion of existing space heating systems to natural gas throughout the nonattainment area. The current (as of 2017) infrastructure serves roughly 1,100 commercial and residential customers. Although current forecasts[33] reflect additional of several thousand additional customers through 2024, there is a degree of uncertainty associated with these projections. Therefore, DEC has conservatively assumed no additional penetration/expansion of natural gas use in 2024.**

Point Source Controls – Finally, emission reductions in 2024 for facility-specific point source SO_2 controls discussed in greater detail in Section III.D.7.7 are summarized by applicable facility and emission unit in Table 7.6-16 2024 Point Source SO_2 Control Reduction Factors**.**

Table 7.6-16
2024 Point Source SO_2 Control Reduction Factors

Facility Name	Emission Unit ID	Fuel	Unit Type	2019 Sulfur Content (%)	Technology - Emission Limit	2024 Control Reduction Factor
GVEA Zehnder	1	Distillate	Turbine	0.237%	Fuel Sulfur Limit - 0.10%	57.8%
	2	Distillate	Turbine	0.315%		68.3%
	3	Naphtha/Jet A	Recip. IC Eng.	0.00150%		0%
	4	Naphtha/Jet A	Recip. IC Eng.	0.00150%		0%
GVEA North Pole	1	Distillate	Turbine	0.239%	Fuel Sulfur Limit - 0.0015% on episode days	99.4%
	2	Distillate	Turbine	0.296%		99.5%
	5	Naphtha/Jet A	Turbine	0.00205%	Fuel Sulfur Limit – 0.005%	0%
	7	Naphtha/Jet A	Recip. IC Eng.	0.00150%	Fuel Sulfur Limit – 0.050%	0%
UAF	3	Fuel Oil	Boiler	0.167%	Fuel Sulfur Limit - 0.0015% on episode days	99.1%
	4	Fuel Oil	Boiler	0.167%		99.1%
Doyon Utilities -	1	Coal	Boiler	0.14%	Dry-Sorbent Injection – 0.12 lb SO_2/mmBTU	63.1%
	2	Coal	Boiler	0.14%		63.1%
	3	Coal	Boiler	0.14%		63.1%

[33] "Quarterly Report to the Alaska State Legislature," Interior Energy Project, April 2020, https://www.interiorgas.com/wpdm-package/2020-q1-legislative-report/

Ft. Wainwright	4	Coal	Boiler	0.14%		63.1%
	5	Coal	Boiler	0.14%		63.1%
	6	Coal	Boiler	0.14%		63.1%

In addition to the fuel and combustion type for each emission unit, Table 7.6-16 2024 Point Source SO_2 Control Reduction Factors **also lists the "baseline" (2019) fuel sulfur content, technology and applicable fuel limit or emission factor, and the resulting calculated 2024 SO_2 control reduction factor. For example, GVEA Zehnder Unit 1 has a baseline distillate sulfur content of 0.237% S. With a fuel sulfur limit of 0.l0% S in effect by 2024, the SO_2 reduction factor of 57.8% was calculated as follows: (0.237% - 0.10%) ÷ 0.237% = 0.578 = 57.8%.**

The 63.1% control factor for application of dry-sorbent injection technology for the Doyon/Ft. Wainwright coal boilers with a 0.12 lb/mmBTU three-hour average SO_2 emission limit reflected a baseline emission factor of 0.325 lb/mmBTU (not listed in Table 7.6-16 2024 Point Source SO_2 Control Reduction Factors**) reflecting the 0.14% sulfur level for these coal units.**

The combined effect of BACT controls across all point source facilities (including emission units not requiring BACT results in a 53% reduction in SO_2 emissions in 2024.

These SO_2 reductions were incorporated into the 2024 Control inventory for the applicable point source facilities and emission units.

7.6.8.2 2024 Attainment Year Emissions

Based on the control measure analysis described in the preceding sub-section a 2024 Control Inventory was developed to evaluate attainment in 2024. As noted earlier, it represents incremental effects of control measures beyond those accounted for in the 2019 Baseline inventory.

Table 7.6-17 presents a similar sector-level summary of the 2024 Control modeling and planning inventories. (Again, Appendix III.D.7.6 contains detailed SCC-level emissions for the 2024 Control inventories.) And Table 7.6-18 provides sector- and pollutant-specific comparisons of the relative changes in emissions between the 2019 Baseline and the 2024 Control inventories (both modeling and planning versions).

Table 7.6-17
2024 Control Episode Average Daily Emissions (tons/day) by Source Sector

	Modeling Inventory *Grid 3 Domain Emissions (tons/day)*					*Planning Inventory* *NA Area Emissions (tons/day)*				
Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point Sources	0.64	11.21	3.01	0.04	0.079	0.62	11.16	2.81	0.03	0.079
Area, Space Heating	1.09	2.87	2.58	10.52	0.156	0.74	2.43	2.27	8.60	0.132
Area, Space Heat, Wood	1.00	0.49	0.17	10.26	0.106	0.67	0.39	0.16	8.39	0.088

Area, Space Heat, Oil	**0.03**	**2.15**	**2.32**	**0.12**	**0.004**	**0.03**	**1.83**	**2.04**	**0.10**	**0.004**
Area, Space Heat, Coal	**0.04**	**0.06**	**0.07**	**0.13**	**0.017**	**0.03**	**0.05**	**0.05**	**0.11**	**0.014**
Area, Space Heat, Other	**0.01**	**0.17**	**0.02**	**0.01**	**0.029**	**0.01**	**0.15**	**0.02**	**0.01**	**0.027**
Area, Other	**0.26**	**0.41**	**0.03**	**2.42**	**0.053**	**0.24**	**0.38**	**0.03**	**2.24**	**0.050**
On-Road Mobile	**0.20**	**1.67**	**0.01**	**4.45**	**0.058**	**0.16**	**1.25**	**0.01**	**3.55**	**0.043**
Non-Road Mobile	**0.36**	**1.79**	**8.88**	**4.60**	**0.003**	**0.24**	**1.02**	**5.59**	**3.64**	**0.002**
TOTALS	**2.54**	**17.95**	**14.51**	**22.02**	**0.350**	**1.99**	**16.24**	**10.71**	**18.06**	**0.306**

Table 7.6-18
Relative Change (%) in Episode Average Daily Emissions (tons/day) by Source Sector, 2024 Control vs. 2019 Baseline

	Modeling Inventory *Change in Grid 3 Domain Emissions (%)*					*Planning Inventory* *Change in NA Area Emissions (%)*				
Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point Sources	+8%	+8%	-49%	+8%	+8%	+8%	+8%	-50%	+8%	+8%
Area, Space Heating	-51%	+10%	-38%	+10%	+8%	-61%	+0%	-42%	+0%	+0%
Area, Space Heat, Wood	-51%	+10%	+0%	+10%	+10%	-62%	+0%	-0%	+0%	+2%
Area, Space Heat, Oil	-50%	+11%	-40%	+10%	+11%	-56%	+1%	-44%	-0%	+1%
Area, Space Heat, Coal	-48%	+8%	-33%	+8%	+9%	-59%	-2%	-39%	-2%	+1%
Area, Space Heat, Other	+0%	+0%	+0%	+0%	+0%	-2%	-9%	+0%	-9%	-7%
Area, Other	+7%	+7%	+7%	+7%	+7%	+7%	+7%	+7%	+7%	+7%
On-Road Mobile	-25%	-27%	-2%	-9%	+6%	-24%	-26%	-0%	-7%	+8%
Non-Road Mobile	-1%	+2%	+14%	-13%	+3%	-8%	+8%	+3%	-13%	+4%
TOTALS	-31%	+3%	-19%	+0%	+8%	-37%	+3%	-29%	-3%	+4%

The relative reductions shown in Table 7.6-18 are for $PM_{2.5}$ and SO_2 only and are restricted to the space heating sector within which the incremental control measures apply.

It is also noted that the control reductions reflected in Table 7.6-17 and Table 7.6-18 are lower than shown earlier for the WSCO Program and the Curtailment Program in Table 7.6-13 and Table 7.6-14
Incremental Curtailment Program Emission Reductions (2024 vs. 2019) **for two reasons. First, Curtailment Program benefits averaged across all modeling episode days are "diluted" from those shown which apply only at the alert thresholds. (The modeling episodes include "spin-up" spin-down" days during which measured ambient concentrations do not exceed these thresholds.) Second, the overlap of the two measures are addressed in Table 7.6-17 and Table 7.6-18 but are not reflected in individual measure benefits reported earlier in Table 7.6-13 and Table 7.6-14**
Incremental Curtailment Program Emission Reductions (2024 vs. 2019)**.**

As further described in Sections III.D.7.9, the 2024 Control Inventory was used to evaluate modeled attainment by 2024. That section also discusses the evaluation of additional control measures and implementation beyond 2019 to support DEC's analysis of the most expeditious attainment date.