

March 18, 2022

Midwest Ozone Group  
c/o David M. Flannery  
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David:

Alpine Geophysics, LLC is pleased to provide the attached summary documenting recent ozone source apportionment modeling and associated results of the EPA 2016v2 modeling platform and associated 2023fj projections in support of MOG's 2022 technical agenda.

We welcome any questions you may have with the information identified in this document.

Regards,

A handwritten signature in black ink, appearing to read "Gregory Stella", with a long horizontal flourish extending to the right.

Gregory Stella  
Managing Partner  
Alpine Geophysics, LLC

## **FUTURE YEAR 2023 CAMX OZONE SOURCE APPORTIONMENT MODELING**

### **Objective**

The objective of this task was to conduct source-receptor relationship modeling and calculate relative contribution metrics related to 8-hour ozone standards across the eastern U.S. It also serves the purpose of developing future year design values and assisting in the establishment of grouped category (EGU, non-EGU point, on-road mobile, etc.) and geography based (local vs. regional) culpability and control strategy development for regional or monitor-specific nonattainment estimates.

### **Technical Approach**

The approach for this work was to utilize the 2023 projection year (2023fj) from EPA's 2016v2 12km modeling platform and source and source category groups defined with work conducted by Alpine in collaboration with MOG.

#### *Ozone Source Apportionment Calculations*

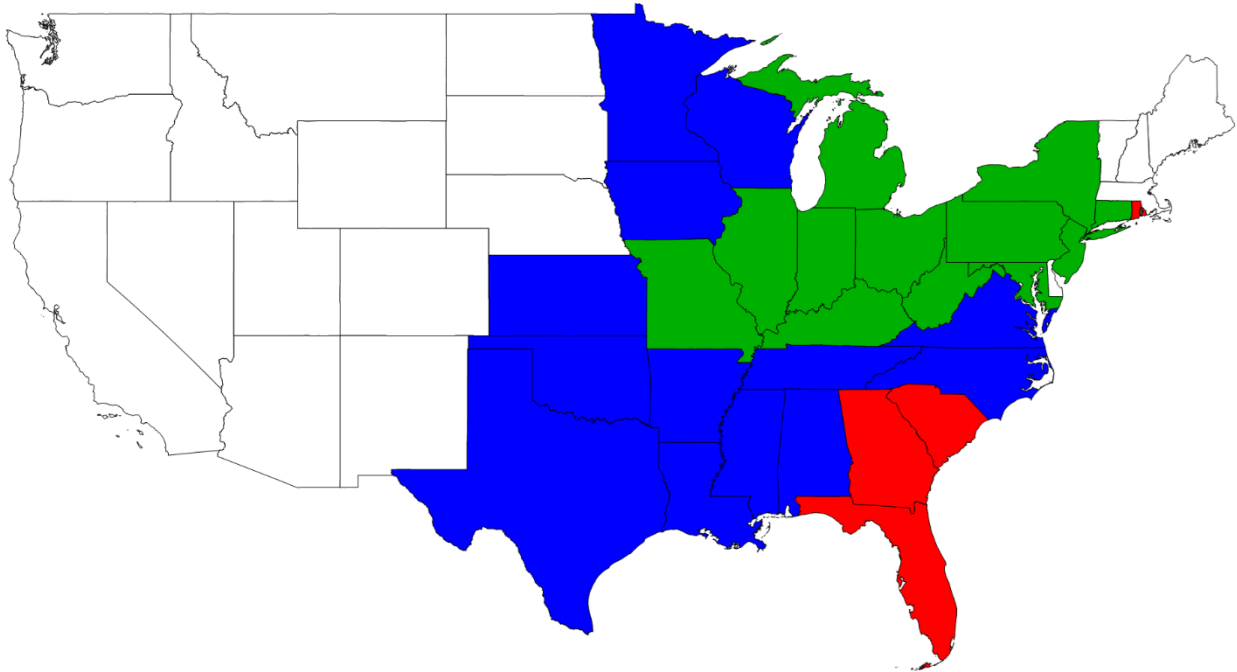
Under this task we performed ozone source apportionment modeling runs using the Comprehensive Air-quality model with extensions (CAMx) Anthropogenic Precursor Culpability Assessment (APCA) algorithms. Source apportionment results were developed for monitors located in the eastern U.S. 12km modeling domain and include State and proposed source category breakouts for five major source categories:

- Biogenic/Fires;
- On-Road Mobile;
- Non-Road Mobile/Stationary Area;
- EGU Point; and
- Non-EGU Point.

States were individually tagged as determined in collaboration with MOG and are identified in Figure 1.

The CAMx/APCA modeling was further used to obtain the ozone signal in terms of ppb ozone at an ozone monitor per ton of emission from each major source category and each geographic region.

Alpine ran the simulation with CAMx version 7.1 using EPA's modeling configuration and meteorological modeling input.



**Figure 1.** OSAT/APCA tagged states. Green indicates states from original proposal. Blue indicates expanded list of states used in MOG modeling. Red indicates list of states included in original EPA SIP review and at time of project initiation were presumed to have SIP approval.

### Key Deliverables

From this project, Alpine developed the following deliverables:

- 2023 future year ozone design values at all monitors in 12km domain
- 2023 APCA ozone source apportionment calculations by state and category
  - Used in relative contribution calculations
  - Differs from EPA results in that contribution are separated into key categories
- Apply alternate calculation methods to nonattainment/maintenance determination
- Estimate impact of Canadian and Mexican anthropogenic emissions on projected design values
- Determine relative impact of individual category emissions to downwind ozone

Additionally, products from this project could further be used to:

- Verify EPA calculations and results
- Comment on NPR using independently modeled results
- Determine contribution using alternate top 10-day selection
- Confirm daily contributions for special studies
- Use results for sensitivity/control strategy modeling

### Projected Design Values

The following tables present the calculated 2023 ozone design values in eastern states using the 2016v2 modeling platform and associated 2023fj projections. Monitors are considered nonattainment (Table 1) if the 2023 average DV > 70.9 ppb. Monitors are considered maintenance (Table 2) if the 2023 average DV < 71.0 ppb, the 2023 Max DV > 70.9 ppb, and the current DV > 70 ppb.

**Table 1.** Projected Nonattainment Monitors (Eastern States) using 2023fj Platform. 2019-2021 DVs considered preliminary.

Monitor	State	County	Local Name	Ozone Design Value (ppb)					
				Base 2016 DV	2023 Ave DV	Base Max DV	2023 Max DV	2018-2020 DV	2019-2021 DV*
090010017	Connecticut	Fairfield	Greenwich Point Park	79.3	73.0	80.0	73.7	82	79
090013007	Connecticut	Fairfield	Prospect Street (USCG Lighthouse)	82.0	74.1	83.0	75.0	80	81
090019003	Connecticut	Fairfield	Sherwood Island Connector	82.7	76.1	83.0	76.4	79	80
090099002	Connecticut	New Haven	Hammonasset State Park	79.7	72.1	82.0	74.3	80	82
481671034	Texas	Galveston	Galveston 99th Street	75.7	71.2	77.0	72.5	74	72
482010024	Texas	Harris	Houston Aldine	79.3	75.5	81.0	77.2	79	74
482010055	Texas	Harris	Houston Bayland Park	76.0	72.2	77.0	73.2	76	79
550590019	Wisconsin	Kenosha	Chiwaukee Prairie Stateline	78.0	73.0	79.0	74.0	74	74
551010020	Wisconsin	Racine	Racine - Payne And Dolan	76.0	71.9	78.0	73.9	73	73
551170006	Wisconsin	Sheboygan	Sheboygan - Kohler Andrae	80.0	73.9	81.0	74.9	75	72

**Table 2.** Projected Maintenance Monitors (Eastern States) using 2023fj Platform. 2019-2021 DVs considered preliminary.

Monitor	State	County	Local Name	Ozone Design Value (ppb)					
				Base 2016 DV	2023 Ave DV	Base Max DV	2023 Max DV	2018-2020 DV	2019-2021 DV*
170310001	Illinois	Cook	Village Garage	73.0	68.8	77.0	72.6	75	71
170310032	Illinois	Cook	South Water Filtration Plant	72.3	69.5	75.0	72.2	74	75
170310076	Illinois	Cook	Com Ed Maintenance Bldg	72.0	68.7	75.0	71.6	69	67
170314201	Illinois	Cook	Northbrook Water Plant	73.3	69.4	77.0	73.0	77	74
170317002	Illinois	Cook	Water Plant	74.0	70.3	77.0	73.2	75	73
420170012	Pennsylvania	Bucks	Long Point Is Of Sampling Inlet	79.3	70.7	81.0	72.3	74	71
480391004	Texas	Brazoria	Manvel Croix Park	74.7	70.8	77.0	73.0	73	76
481210034	Texas	Denton	Denton Airport South	78.0	70.5	80.0	72.3	72	74
481410037	Texas	El Paso	El Paso Utep	71.3	69.6	73.0	71.3	76	75
482010047	Texas	Harris	Lang	73.7	69.5	76.0	71.7	72	71
482010416	Texas	Harris	Park Place	72.3	69.7	74.0	71.4	73	73
482011034	Texas	Harris	Houston East	73.7	70.0	75.0	71.3	73	71
482011035	Texas	Harris	Clinton	71.3	67.7	75.0	71.3	70	71
550590025	Wisconsin	Kenosha	Kenosha - Water Tower	73.7	68.0	77.0	71.1	74	72

### Alternate Design Value Calculations

In addition to the standard calculation of design values using the 3x3 neighborhood of grid cells (excluding grid cells with water representing > 50% of cell area), we calculated 2023 design values for the nonattainment monitors using the following methods:

- 3x3 method, including water cells, top 10 modeled days
- 3x3 method, water cells excluded (unless contains monitor)
- 3x3 method, water cells excluded, bias constrained (< 15% NBias)
- 1x1 method, grid cell center only (cell with monitor)
- 3x3 method, water cells excluded, 2016 exceedance days

Table 3 below presents these results for the eastern state nonattainment monitors estimated using MOG’s modeling.

**Table 3.** Alternate method design values calculated for eastern state nonattainment monitors.

Monitor	State	County	Local Name	Ozone Design Value (ppb)					
				Modeled 2016 DV	With Water 3x3 - 2023 DV	No Water 3x3 - 2023 DV	No Water 3x3 - Bias Filter - 2023 DV	Grid Center 1x1 - 2023 DV	2016 Exceedance Days - 2023 DV
090010017	Connecticut	Fairfield	Greenwich Point Park	79.3	75.3	73.0	72.8	74.0	73.8
090013007	Connecticut	Fairfield	Stratford	82.0	74.7	74.1	74.9	74.7	74.8
090019003	Connecticut	Fairfield	Westport-Sherwood Island Connector	82.7	76.8	76.1	77.2	75.7	77.2
090099002	Connecticut	New Haven	Madison-Hammonasset State Park	79.7	72.1	72.1	72.4	71.7	72.3
481671034	Texas	Galveston	Galveston 99th Street	75.7	71.3	71.2	71.7	71.2	72.6
482010024	Texas	Harris	Houston Aldine	79.3	75.5	75.5	74.6	74.8	76.0
482010055	Texas	Harris	Houston Bayland Park	76.0	72.2	72.2	71.9	73.0	73.6
550590019	Wisconsin	Kenosha	Chiwaukee Prairie Stateline	78.0	73.3	73.0	73.1	73.0	74.4
551010020	Wisconsin	Racine	Racine - Payne And Dolan	76.0	71.1	71.9	71.9	71.9	73.4
551170006	Wisconsin	Sheboygan	Sheboygan - Kohler Andrae	80.0	74.6	73.9	73.8	74.4	75.2

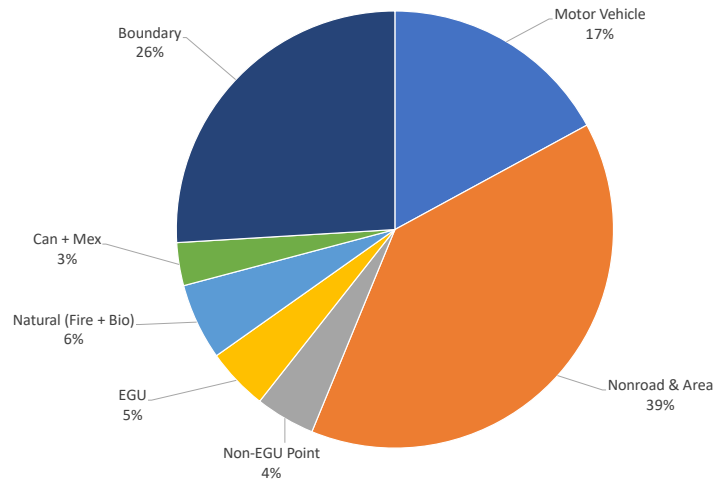
### Source Apportionment Results

For each monitor in the modeling domain, Alpine also produced a standard set of products representing the relative contribution of region and category emissions to projected 2023 ozone concentrations. The following figures (Figures 2 through 11) present information on the relative ppb contribution of source region (state) and major category to each nonattainment monitor (upper left table), an aggregated view of major source category relative contribution across all regions (pie chart in upper right), and a stacked bar chart representing the regional and category based relative contribution from the upper left-hand table (bottom).

Additional calculations representing estimated significant contribution using 1% and 1 ppb thresholds, and a calculated future year design value absent the contribution of Canadian and Mexican anthropogenic emissions have been developed and are not presented here. Also in progress is the calculation of Alpine’s Impact Factor which represents a relative contribution of modeled emissions (tons) to resultant ozone concentrations (in ppb). This factor can be useful in determining which states and categories are the largest ppb/ton contributors to each monitor and the results may be used in assisting policy makers in the development of control strategies and their relative impact on ozone concentrations at various locations.

Monitor	Fairfield Co, Connecticut										Average 2023 DV (ppb) ->
90010017											73.0
APCA Relative Contribution (ppb) - Scaled to 2023 Avg DV - Future Modeled Days ≥ 60 ppb											
State	Motor Vehicle	Nonroad & Area	Non-EGU Point	EGU	Natural (Fire + Bio)	Can + Mex	Boundary	Total	Total	Total	
									Anthro	Anthro	
AL	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.03	0.03	0.03	
AR	0.03	0.04	0.02	0.01	0.00	0.00	0.00	0.10	0.10	0.10	
CT	3.37	8.53	0.05	0.07	0.00	0.00	0.00	12.03	12.03	12.03	
DE	0.08	0.19	0.07	0.06	0.00	0.00	0.00	0.40	0.40	0.40	
IA	0.02	0.04	0.01	0.02	0.00	0.00	0.00	0.09	0.09	0.09	
IL	0.12	0.28	0.12	0.09	0.00	0.00	0.00	0.61	0.61	0.61	
IN	0.24	0.27	0.13	0.15	0.00	0.00	0.00	0.79	0.79	0.79	
KS	0.02	0.03	0.01	0.00	0.00	0.00	0.00	0.07	0.07	0.07	
KY	0.15	0.17	0.14	0.07	0.00	0.00	0.00	0.52	0.52	0.52	
LA	0.02	0.04	0.05	0.01	0.00	0.00	0.00	0.12	0.12	0.12	
MD	0.20	0.36	0.07	0.05	0.00	0.00	0.00	0.67	0.67	0.67	
MI	0.26	0.45	0.21	0.15	0.00	0.00	0.00	1.07	1.07	1.07	
MN	0.02	0.06	0.04	0.02	0.00	0.00	0.00	0.14	0.14	0.14	
MO	0.05	0.05	0.01	0.02	0.00	0.00	0.00	0.13	0.13	0.13	
MS	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.06	0.06	0.06	
NC	0.04	0.06	0.03	0.05	0.00	0.00	0.00	0.19	0.19	0.19	
NJ	3.06	6.76	0.65	0.68	0.00	0.00	0.00	11.15	11.15	11.15	
NY	2.79	6.89	0.41	1.13	0.00	0.00	0.00	11.22	11.22	11.22	
OH	0.25	0.50	0.25	0.17	0.00	0.00	0.00	1.18	1.18	1.18	
OK	0.02	0.04	0.03	0.00	0.00	0.00	0.00	0.08	0.08	0.08	
PA	1.23	2.16	0.60	0.40	0.00	0.00	0.00	4.39	4.39	4.39	
TN	0.05	0.05	0.02	0.00	0.00	0.00	0.00	0.13	0.13	0.13	
TX	0.06	0.14	0.05	0.03	0.00	0.00	0.00	0.28	0.28	0.28	
VA	0.13	0.22	0.06	0.03	0.00	0.00	0.00	0.45	0.45	0.45	
WI	0.04	0.05	0.02	0.01	0.00	0.00	0.00	0.12	0.12	0.12	
WV	0.04	0.25	0.07	0.09	0.00	0.00	0.00	0.45	0.45	0.45	
Other	0.16	0.88	0.07	0.02	0.00	0.00	0.00	1.13	1.13	1.13	
Can + Mex	0.00	0.00	0.00	0.00	0.00	2.32	0.00	2.32	0.00	0.00	
Natural	0.00	0.00	0.00	0.00	4.13	0.00	0.00	4.13	0.00	0.00	
ICBC	0.00	0.00	0.00	0.00	0.00	0.00	18.95	18.95	0.00	0.00	
<b>Total</b>	<b>13.94</b>	<b>31.94</b>	<b>3.61</b>	<b>3.75</b>	<b>4.62</b>	<b>2.60</b>	<b>21.19</b>	<b>73.00</b>	<b>47.60</b>	<b>47.60</b>	

Relative Contribution to Monitor 90010017: Fairfield Co, Connecticut (73.0 ppb) - 2023v2



Relative Contribution to Monitor 90010017: Fairfield Co, Connecticut (73.0 ppb) - 2023v2

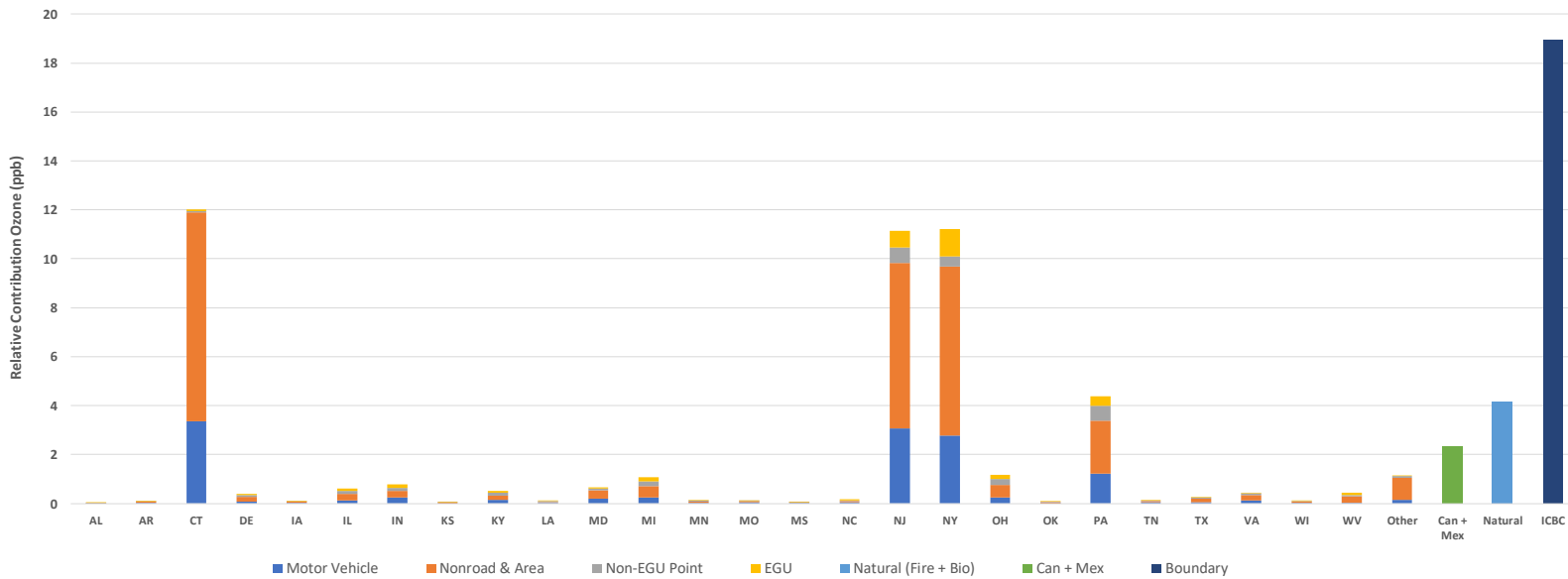


Figure 2. 2023 source apportionment results for Fairfield Co, CT monitor 90010017 using top 10 future year modeled days.

Monitor	90013007		Fairfield Co, Connecticut		Average 2023 DV (ppb) ->		74.1		
APCA Relative Contribution (ppb) - Scaled to 2023 Avg DV - Future Modeled Days ≥ 60 ppb									
State	Motor Vehicle	Nonroad & Area	Non-EGU Point	EGU	Natural (Fire + Bio)	Can + Mex	Boundary	Total	Total Anthro
AL	0.04	0.03	0.04	0.01	0.00	0.00	0.00	0.13	0.13
AR	0.04	0.07	0.03	0.02	0.00	0.00	0.00	0.17	0.17
CT	1.23	3.23	0.05	0.68	0.00	0.00	0.00	5.18	5.18
DE	0.12	0.29	0.12	0.09	0.00	0.00	0.00	0.62	0.62
IA	0.03	0.05	0.02	0.02	0.00	0.00	0.00	0.11	0.11
IL	0.14	0.31	0.15	0.12	0.00	0.00	0.00	0.72	0.72
IN	0.27	0.27	0.15	0.19	0.00	0.00	0.00	0.88	0.88
KS	0.03	0.06	0.02	0.01	0.00	0.00	0.00	0.11	0.11
KY	0.24	0.26	0.21	0.12	0.00	0.00	0.00	0.83	0.83
LA	0.05	0.09	0.10	0.03	0.00	0.00	0.00	0.27	0.27
MD	0.34	0.62	0.12	0.09	0.00	0.00	0.00	1.16	1.16
MI	0.22	0.36	0.20	0.16	0.00	0.00	0.00	0.94	0.94
MN	0.03	0.07	0.05	0.01	0.00	0.00	0.00	0.16	0.16
MO	0.09	0.07	0.01	0.02	0.00	0.00	0.00	0.20	0.20
MS	0.03	0.04	0.03	0.01	0.00	0.00	0.00	0.11	0.11
NC	0.15	0.18	0.08	0.09	0.00	0.00	0.00	0.50	0.50
NJ	2.93	6.52	0.69	0.73	0.00	0.00	0.00	10.86	10.86
NY	2.69	5.96	0.40	1.33	0.00	0.00	0.00	10.38	10.38
OH	0.43	0.77	0.39	0.36	0.00	0.00	0.00	1.95	1.95
OK	0.03	0.06	0.05	0.01	0.00	0.00	0.00	0.14	0.14
PA	1.35	2.52	0.74	0.56	0.00	0.00	0.00	5.18	5.18
TN	0.11	0.09	0.05	0.01	0.00	0.00	0.00	0.26	0.26
TX	0.11	0.24	0.09	0.05	0.00	0.00	0.00	0.49	0.49
VA	0.35	0.51	0.13	0.08	0.00	0.00	0.00	1.07	1.07
WI	0.05	0.07	0.03	0.01	0.00	0.00	0.00	0.15	0.15
WV	0.07	0.48	0.13	0.17	0.00	0.00	0.00	0.85	0.85
Other	0.43	1.73	0.19	0.10	0.00	0.00	0.00	2.45	2.45
Can + Mex	0.00	0.00	0.00	0.00	0.00	1.84	0.00	1.84	0.00
Natural	0.00	0.00	0.00	0.00	5.16	0.00	0.00	5.16	0.00
ICBC	0.00	0.00	0.00	0.00	0.00	0.00	21.23	21.23	0.00
<b>Total</b>	<b>11.35</b>	<b>24.43</b>	<b>4.18</b>	<b>4.97</b>	<b>5.05</b>	<b>1.80</b>	<b>20.80</b>	<b>74.10</b>	<b>45.87</b>

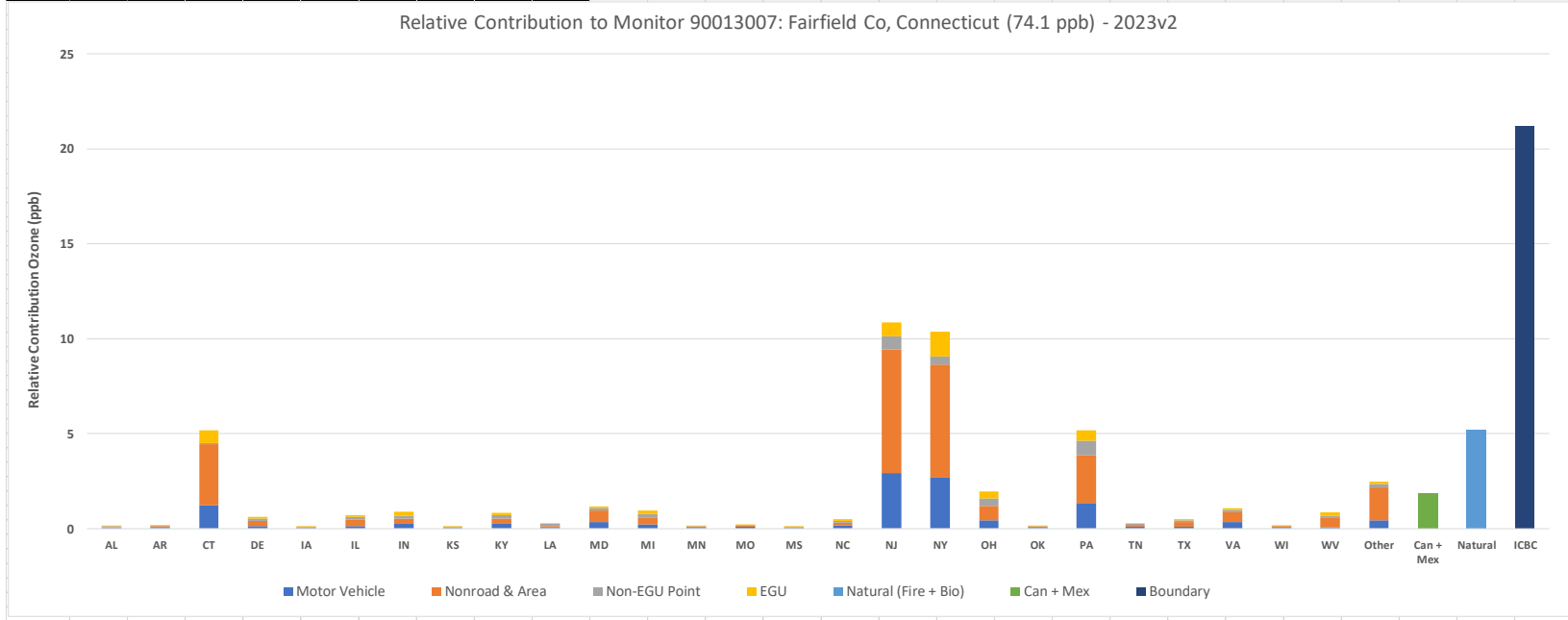
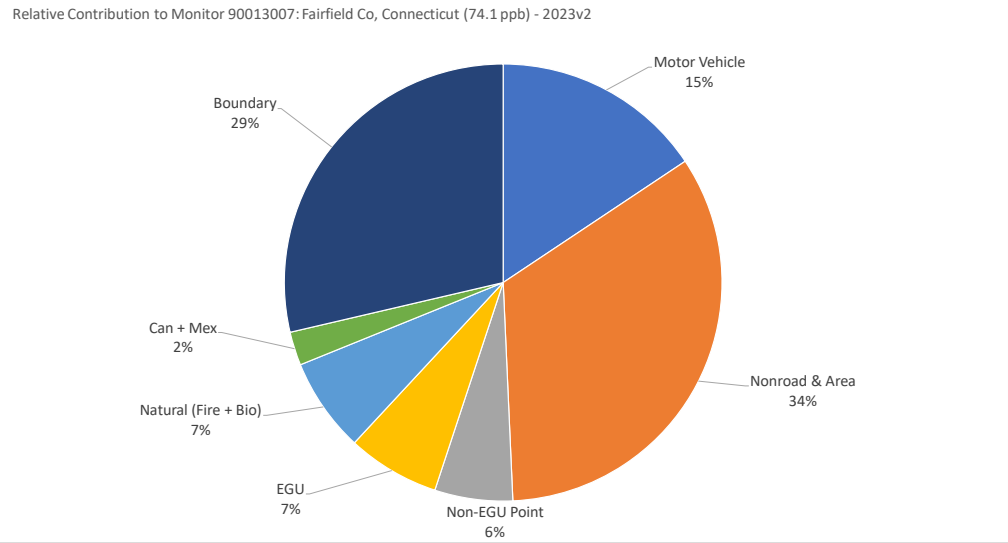


Figure 3. 2023 source apportionment results for Fairfield Co, CT monitor 90013007 using top 10 future year modeled days.

Monitor	Fairfield Co, Connecticut				Average 2023 DV (ppb) ->					76.1
APCA Relative Contribution (ppb) - Scaled to 2023 Avg DV - Future Modeled Days ≥ 60 ppb										
State	Motor Vehicle	Nonroad & Area	Non-EGU Point	EGU	Natural (Fire + Bio)	Can + Mex	Boundary	Total	Total Anthro	
AL	0.05	0.03	0.04	0.01	0.00	0.00	0.00	0.13	0.13	
AR	0.04	0.07	0.03	0.02	0.00	0.00	0.00	0.17	0.17	
CT	1.11	2.73	0.03	0.16	0.00	0.00	0.00	4.03	4.03	
DE	0.13	0.20	0.12	0.10	0.00	0.00	0.00	0.65	0.65	
IA	0.03	0.05	0.02	0.02	0.00	0.00	0.00	0.11	0.11	
IL	0.14	0.31	0.15	0.12	0.00	0.00	0.00	0.71	0.71	
IN	0.27	0.28	0.15	0.20	0.00	0.00	0.00	0.89	0.89	
KS	0.03	0.06	0.02	0.01	0.00	0.00	0.00	0.11	0.11	
KY	0.26	0.28	0.22	0.12	0.00	0.00	0.00	0.88	0.88	
LA	0.05	0.09	0.11	0.03	0.00	0.00	0.00	0.27	0.27	
MD	0.36	0.63	0.12	0.09	0.00	0.00	0.00	1.20	1.20	
MI	0.21	0.35	0.20	0.15	0.00	0.00	0.00	0.91	0.91	
MN	0.03	0.07	0.05	0.01	0.00	0.00	0.00	0.15	0.15	
MO	0.09	0.08	0.01	0.03	0.00	0.00	0.00	0.20	0.20	
MS	0.03	0.04	0.03	0.01	0.00	0.00	0.00	0.11	0.11	
NC	0.15	0.18	0.08	0.09	0.00	0.00	0.00	0.50	0.50	
NJ	3.50	7.88	0.79	0.83	0.00	0.00	0.00	12.99	12.99	
NY	2.64	6.15	0.40	1.32	0.00	0.00	0.00	10.52	10.52	
OH	0.44	0.78	0.39	0.36	0.00	0.00	0.00	1.97	1.97	
OK	0.03	0.06	0.05	0.01	0.00	0.00	0.00	0.15	0.15	
PA	1.47	2.71	0.79	0.58	0.00	0.00	0.00	5.55	5.55	
TN	0.12	0.09	0.05	0.01	0.00	0.00	0.00	0.27	0.27	
TX	0.11	0.26	0.09	0.05	0.00	0.00	0.00	0.51	0.51	
VA	0.36	0.51	0.13	0.08	0.00	0.00	0.00	1.07	1.07	
WI	0.05	0.06	0.03	0.01	0.00	0.00	0.00	0.15	0.15	
WV	0.08	0.50	0.13	0.18	0.00	0.00	0.00	0.89	0.89	
Other	0.43	1.62	0.19	0.10	0.00	0.00	0.00	2.36	2.36	
Can + Mex	0.00	0.00	0.00	0.00	0.00	1.76	0.00	1.76	0.00	
Natural	0.00	0.00	0.00	0.00	5.24	0.00	0.00	5.24	0.00	
ICBC	0.00	0.00	0.00	0.00	0.00	0.00	21.61	21.61	0.00	
<b>Total</b>	<b>12.00</b>	<b>25.78</b>	<b>4.38</b>	<b>4.62</b>	<b>5.17</b>	<b>1.73</b>	<b>21.28</b>	<b>76.10</b>	<b>47.49</b>	

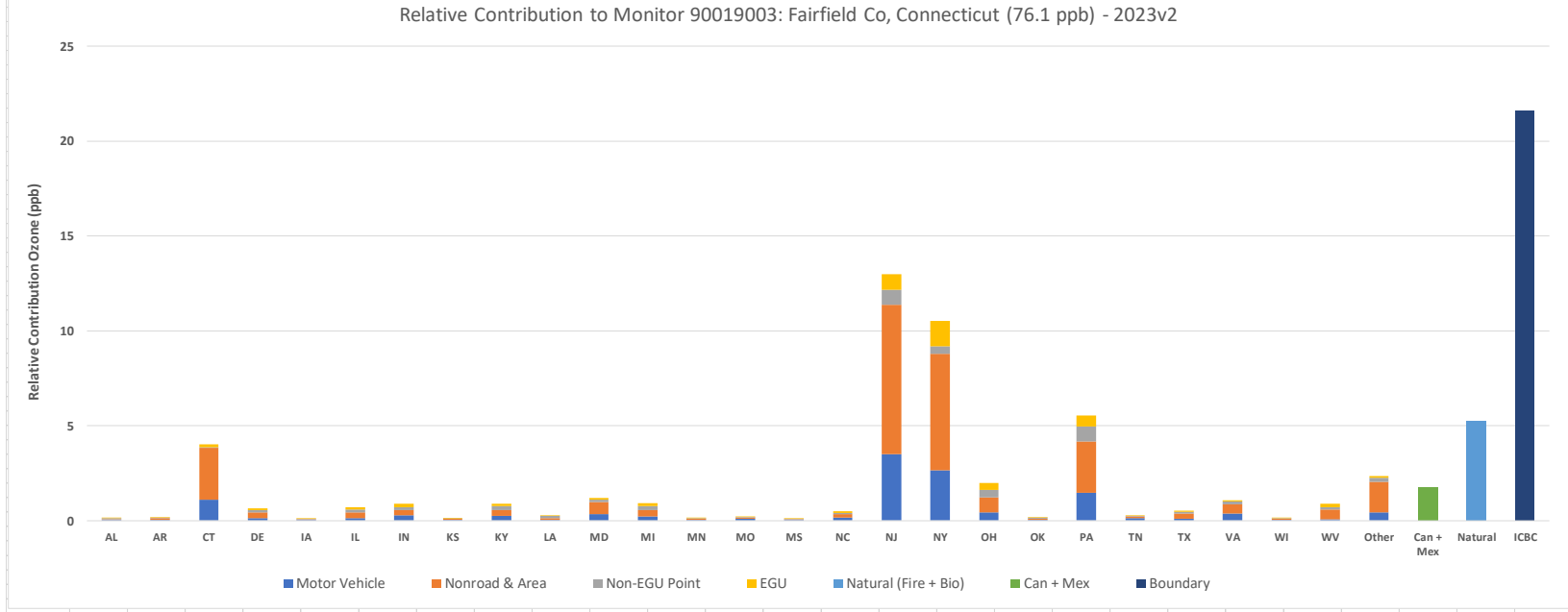
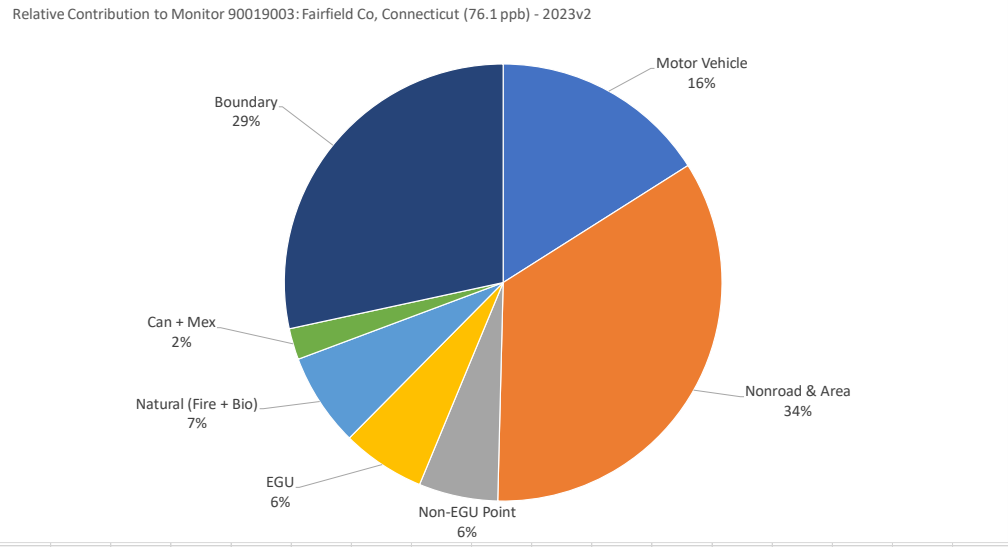
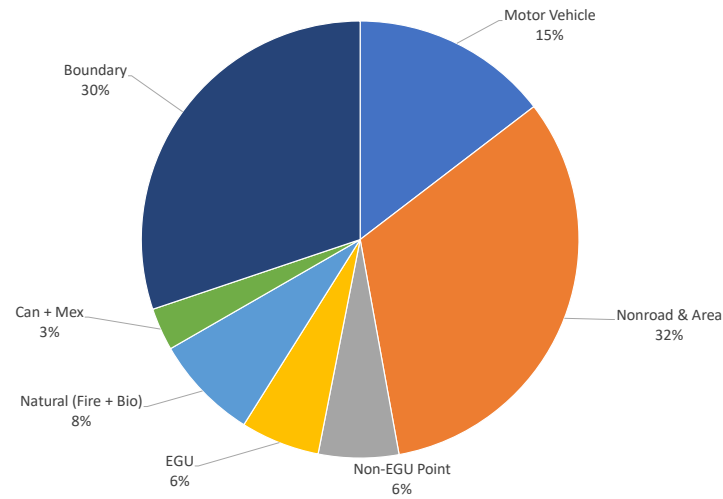


Figure 4. 2023 source apportionment results for Fairfield Co, CT monitor 90019003 using top 10 future year modeled days.



Monitor	New Haven Co, Connecticut										Average 2023 DV (ppb) ->
90099002											71.8
APCA Relative Contribution (ppb) - Scaled to 2023 Avg DV - Future Modeled Days ≥ 60 ppb											
State	Motor Vehicle	Nonroad & Area	Non-EGU Point	EGU	Natural (Fire + Bio)	Can + Mex	Boundary	Total	Total Anthro		
AL	0.04	0.03	0.04	0.01	0.00	0.00	0.00	0.12	0.12		
AR	0.04	0.06	0.03	0.02	0.00	0.00	0.00	0.15	0.15		
CT	1.07	2.75	0.09	0.39	0.00	0.00	0.00	4.30	4.30		
DE	0.15	0.25	0.14	0.11	0.00	0.00	0.00	0.76	0.76		
IA	0.04	0.08	0.03	0.03	0.00	0.00	0.00	0.18	0.18		
IL	0.17	0.41	0.18	0.11	0.00	0.00	0.00	0.87	0.87		
IN	0.30	0.33	0.17	0.19	0.00	0.00	0.00	0.99	0.99		
KS	0.02	0.05	0.02	0.01	0.00	0.00	0.00	0.10	0.10		
KY	0.23	0.27	0.20	0.11	0.00	0.00	0.00	0.81	0.81		
LA	0.03	0.07	0.08	0.02	0.00	0.00	0.00	0.19	0.19		
MD	0.38	0.73	0.12	0.11	0.00	0.00	0.00	1.35	1.35		
MI	0.31	0.53	0.24	0.20	0.00	0.00	0.00	1.28	1.28		
MN	0.04	0.11	0.07	0.02	0.00	0.00	0.00	0.25	0.25		
MO	0.08	0.07	0.01	0.02	0.00	0.00	0.00	0.19	0.19		
MS	0.03	0.03	0.02	0.01	0.00	0.00	0.00	0.09	0.09		
NC	0.20	0.21	0.10	0.15	0.00	0.00	0.00	0.66	0.66		
NJ	2.10	4.71	0.60	0.58	0.00	0.00	0.00	8.00	8.00		
NY	2.56	5.89	0.37	0.90	0.00	0.00	0.00	9.72	9.72		
OH	0.45	0.81	0.44	0.35	0.00	0.00	0.00	2.05	2.05		
OK	0.02	0.04	0.04	0.00	0.00	0.00	0.00	0.11	0.11		
PA	0.92	1.77	0.55	0.40	0.00	0.00	0.00	3.65	3.65		
TN	0.09	0.08	0.06	0.01	0.00	0.00	0.00	0.24	0.24		
TX	0.07	0.17	0.06	0.03	0.00	0.00	0.00	0.34	0.34		
VA	0.54	0.75	0.20	0.12	0.00	0.00	0.00	1.61	1.61		
WI	0.06	0.08	0.03	0.01	0.00	0.00	0.00	0.18	0.18		
WV	0.09	0.57	0.15	0.19	0.00	0.00	0.00	1.00	1.00		
Other	0.42	2.41	0.22	0.09	0.00	0.00	0.00	3.15	3.15		
Can + Mex	0.00	0.00	0.00	0.00	0.00	2.26	0.00	2.26	0.00		
Natural	0.00	0.00	0.00	0.00	5.57	0.00	0.00	5.57	0.00		
ICBC	0.00	0.00	0.00	0.00	0.00	0.00	21.66	21.66	0.00		
<b>Total</b>	<b>10.03</b>	<b>22.38</b>	<b>4.08</b>	<b>4.01</b>	<b>5.34</b>	<b>2.17</b>	<b>20.74</b>	<b>71.80</b>	<b>42.30</b>		

Relative Contribution to Monitor 90099002: New Haven Co, Connecticut (71.8 ppb) - 2023v2



Relative Contribution to Monitor 90099002: New Haven Co, Connecticut (71.8 ppb) - 2023v2

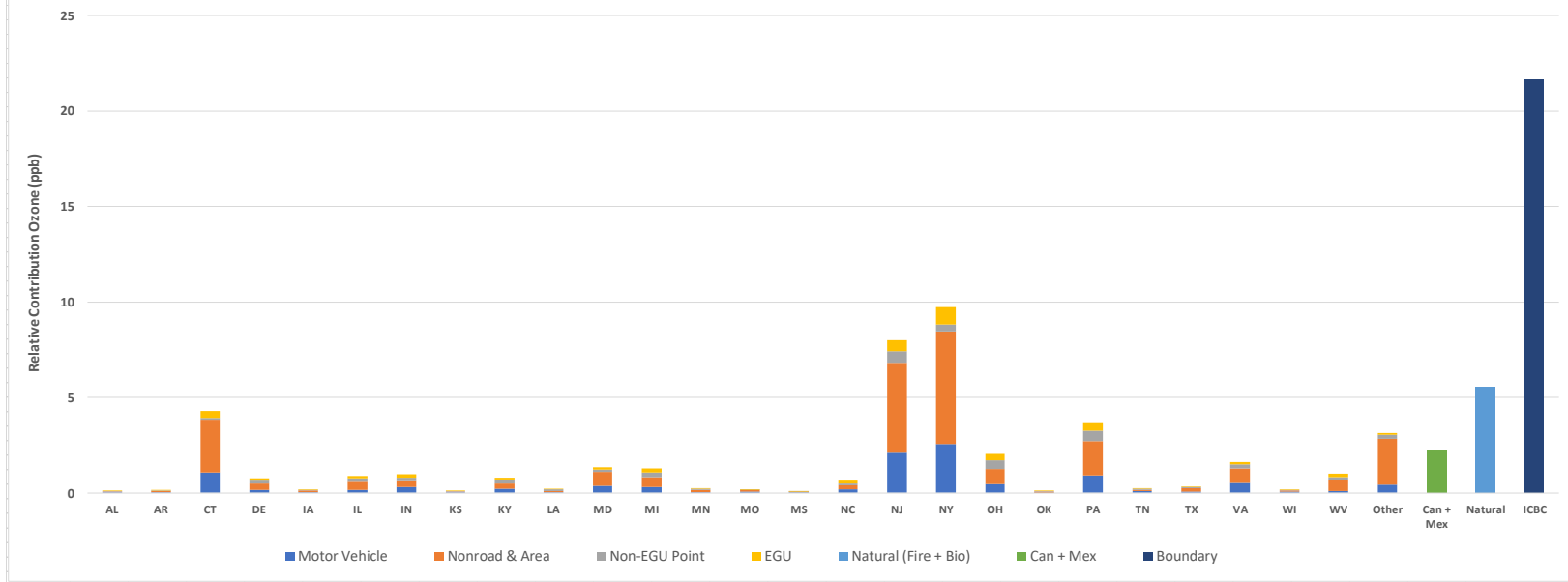


Figure 5. 2023 source apportionment results for New Haven Co, CT monitor 90099002 using top 10 future year modeled days.

Monitor	Galveston Co, Texas										Average 2023 DV (ppb) ->	71.2
APCA Relative Contribution (ppb) - Scaled to 2023 Avg DV - Future Modeled Days ≥ 60 ppb												
State	Motor Vehicle	Nonroad & Area	Non-EGU Point	EGU	Natural (Fire + Bio)	Can + Mex	Boundary	Total	Total Anthro			
AL	0.60	0.50	0.62	0.24	0.00	0.00	0.00	1.96	1.96			
AR	0.35	0.57	0.34	0.17	0.00	0.00	0.00	1.44	1.44			
CT	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01			
DE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01			
IA	0.02	0.03	0.01	0.03	0.00	0.00	0.00	0.09	0.09			
IL	0.03	0.08	0.04	0.04	0.00	0.00	0.00	0.19	0.19			
IN	0.06	0.08	0.09	0.12	0.00	0.00	0.00	0.35	0.35			
KS	0.14	0.35	0.12	0.02	0.00	0.00	0.00	0.62	0.62			
KY	0.07	0.08	0.06	0.02	0.00	0.00	0.00	0.22	0.22			
LA	1.91	3.24	7.97	1.26	0.00	0.00	0.00	14.38	14.38			
MD	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01			
MI	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.03	0.03			
MN	0.03	0.07	0.04	0.01	0.00	0.00	0.00	0.15	0.15			
MO	0.15	0.18	0.03	0.02	0.00	0.00	0.00	0.37	0.37			
MS	0.53	0.52	0.52	0.20	0.00	0.00	0.00	1.77	1.77			
NC	0.02	0.05	0.02	0.01	0.00	0.00	0.00	0.10	0.10			
NJ	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.03	0.03			
NY	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.03			
OH	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.03	0.03			
OK	0.17	0.31	0.25	0.01	0.00	0.00	0.00	0.75	0.75			
PA	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.03	0.03			
TN	0.27	0.25	0.07	0.02	0.00	0.00	0.00	0.61	0.61			
TX	1.47	5.26	4.03	0.73	0.00	0.00	0.00	11.49	11.49			
VA	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.03	0.03			
WI	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.05	0.05			
WV	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01			
Other	0.65	8.46	1.23	0.15	0.00	0.00	0.00	10.50	10.50			
Can + Mex	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.42	0.00			
Natural	0.00	0.00	0.00	0.00	8.24	0.00	0.00	8.24	0.00			
ICBC	0.00	0.00	0.00	0.00	0.00	0.00	17.29	17.29	0.00			
<b>Total</b>	<b>5.75</b>	<b>17.78</b>	<b>13.67</b>	<b>2.70</b>	<b>7.26</b>	<b>0.37</b>	<b>15.24</b>	<b>71.20</b>	<b>45.26</b>			

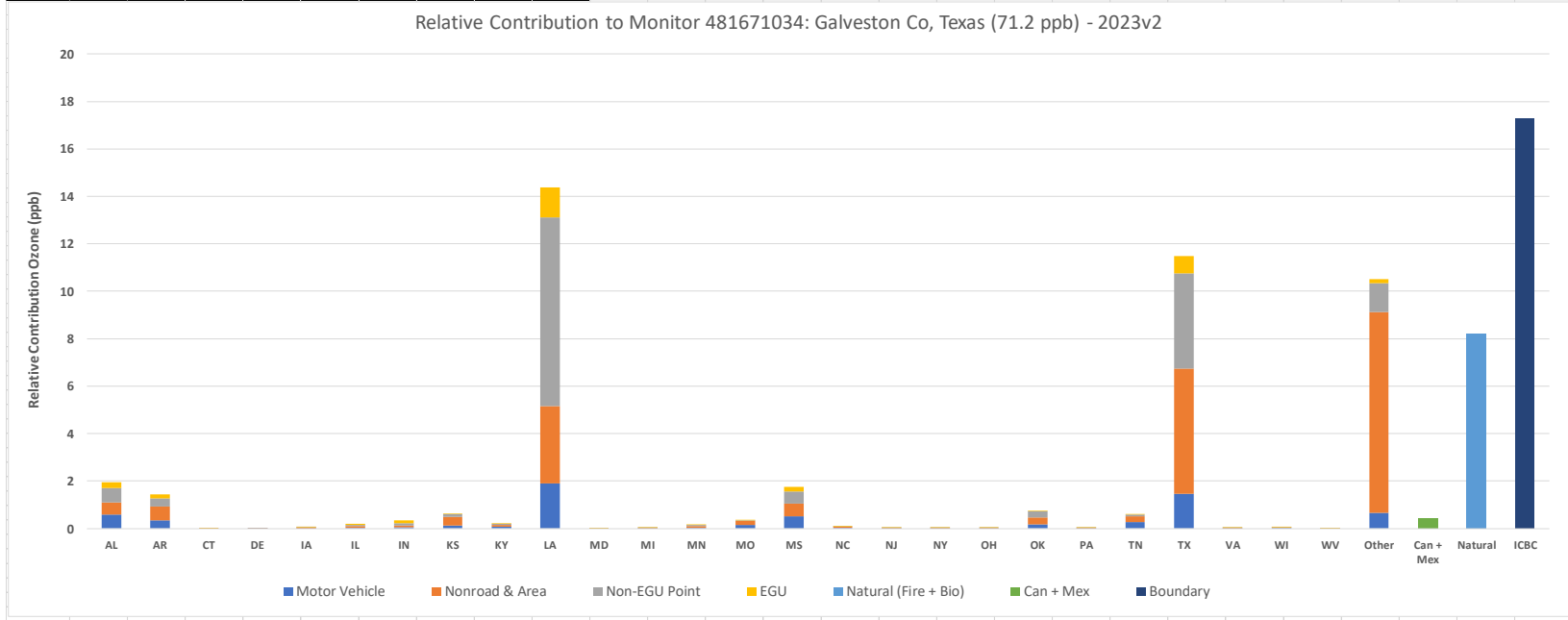
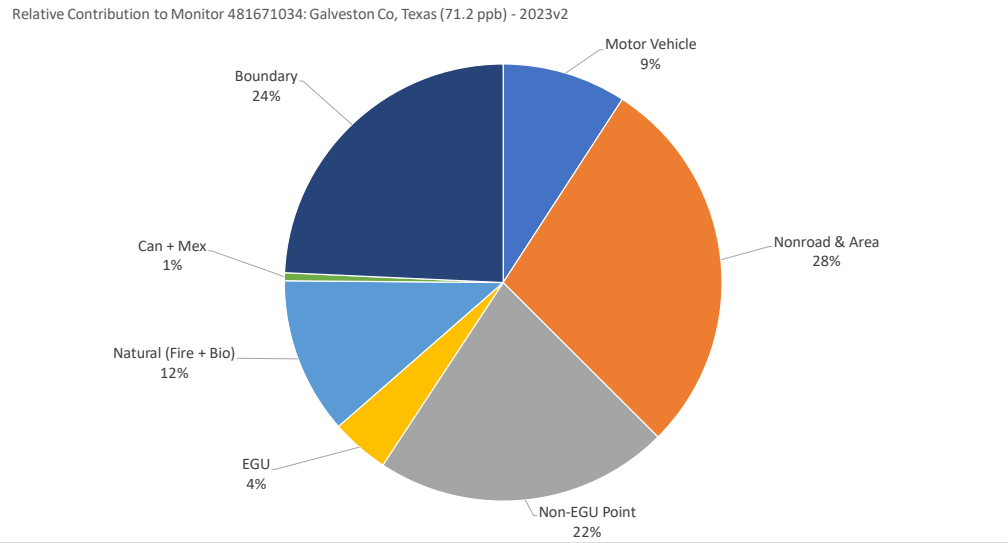
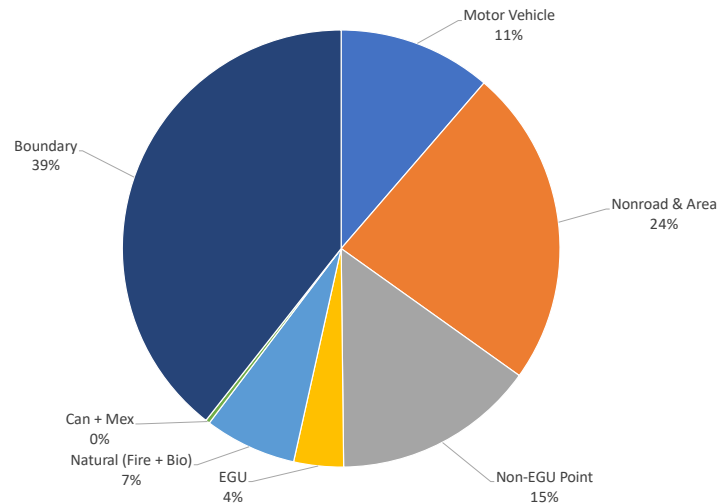


Figure 6. 2023 source apportionment results for Galveston Co, TX monitor 481671034 using top 10 future year modeled days.

Monitor	Harris Co, Texas					Average 2023 DV (ppb) ->					75.5
APCA Relative Contribution (ppb) - Scaled to 2023 Avg DV - Future Modeled Days ≥ 60 ppb											
State	Motor Vehicle	Nonroad & Area	Non-EGU Point	EGU	Natural (Fire + Bio)	Can + Mex	Boundary	Total	Total	Total	
AL	0.13	0.15	0.26	0.01	0.00	0.00	0.00	0.56	0.56		
AR	0.23	0.31	0.21	0.09	0.00	0.00	0.00	0.83	0.83		
CT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
DE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
IA	0.04	0.12	0.02	0.05	0.00	0.00	0.00	0.24	0.24		
IL	0.01	0.03	0.02	0.01	0.00	0.00	0.00	0.07	0.07		
IN	0.05	0.09	0.03	0.03	0.00	0.00	0.00	0.21	0.21		
KS	0.12	0.27	0.08	0.03	0.00	0.00	0.00	0.51	0.51		
KY	0.04	0.05	0.03	0.03	0.00	0.00	0.00	0.15	0.15		
LA	0.78	1.69	2.59	0.54	0.00	0.00	0.00	5.60	5.60		
MD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
MI	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.03	0.03		
MN	0.03	0.09	0.04	0.01	0.00	0.00	0.00	0.17	0.17		
MO	0.10	0.11	0.02	0.01	0.00	0.00	0.00	0.25	0.25		
MS	0.22	0.26	0.26	0.07	0.00	0.00	0.00	0.80	0.80		
NC	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.02		
NJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
NY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
OH	0.05	0.08	0.03	0.01	0.00	0.00	0.00	0.17	0.17		
OK	0.13	0.23	0.25	0.01	0.00	0.00	0.00	0.61	0.61		
PA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
TN	0.06	0.06	0.03	0.00	0.00	0.00	0.00	0.14	0.14		
TX	6.52	12.74	7.39	1.85	0.00	0.00	0.00	28.50	28.50		
VA	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.02		
WI	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.04	0.04		
WV	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.02		
Other	0.00	1.44	0.00	0.00	0.00	0.00	0.00	1.44	1.44		
Can + Mex	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.23	0.00		
Natural	0.00	0.00	0.00	0.00	5.13	0.00	0.00	5.13	0.00		
ICBC	0.00	0.00	0.00	0.00	0.00	0.00	29.74	29.74	0.00		
<b>Total</b>	<b>7.36</b>	<b>15.31</b>	<b>9.72</b>	<b>2.39</b>	<b>4.42</b>	<b>0.20</b>	<b>25.62</b>	<b>75.50</b>	<b>40.39</b>		

Relative Contribution to Monitor 482010024: Harris Co, Texas (75.5 ppb) - 2023v2



Relative Contribution to Monitor 482010024: Harris Co, Texas (75.5 ppb) - 2023v2

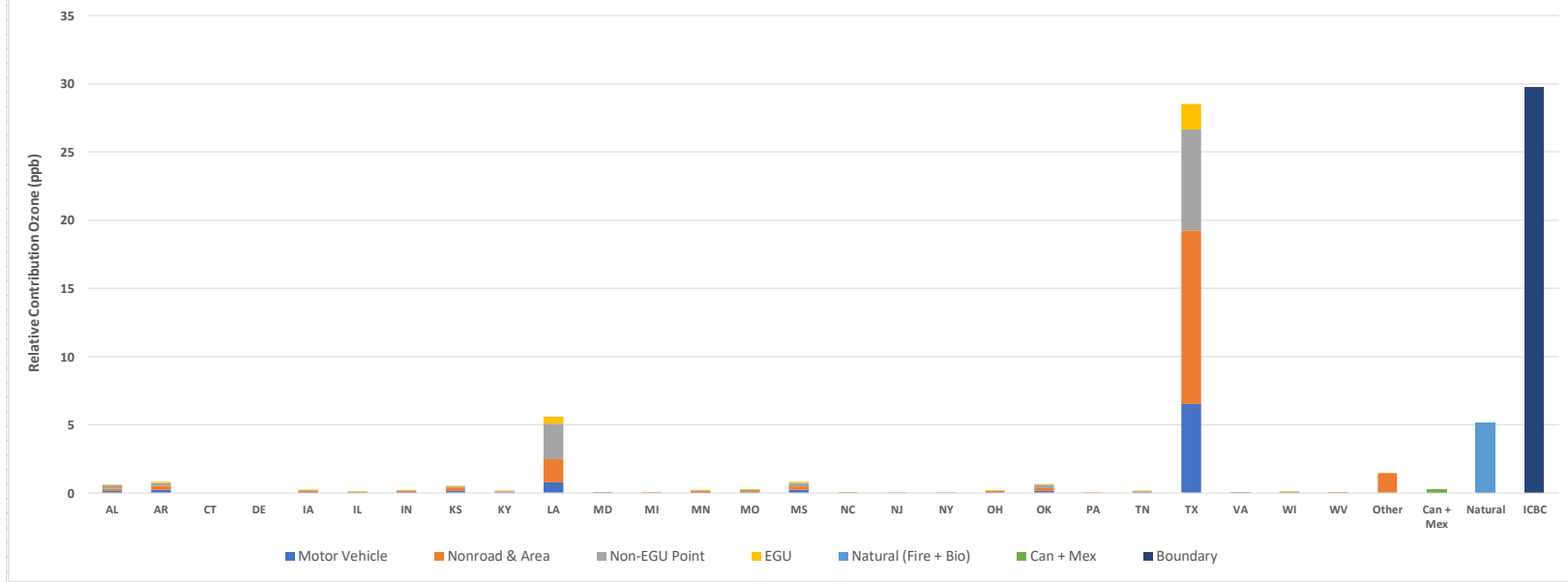


Figure 7. 2023 source apportionment results for Harris Co, TX monitor 482010024 using top 10 future year modeled days.

Monitor	Harris Co, Texas				Average 2023 DV (ppb) ->				72.2
APCA Relative Contribution (ppb) - Scaled to 2023 Avg DV - Future Modeled Days ≥ 60 ppb									
State	Motor Vehicle	Nonroad & Area	Non-EGU Point	EGU	Natural (Fire + Bio)	Can + Mex	Boundary	Total	Total Anthro
AL	0.30	0.29	0.39	0.10	0.00	0.00	0.00	1.08	1.08
AR	0.22	0.34	0.22	0.10	0.00	0.00	0.00	0.88	0.88
CT	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01
DE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
IA	0.05	0.12	0.03	0.05	0.00	0.00	0.00	0.25	0.25
IL	0.06	0.15	0.08	0.06	0.00	0.00	0.00	0.35	0.35
IN	0.10	0.15	0.09	0.10	0.00	0.00	0.00	0.44	0.44
KS	0.12	0.26	0.08	0.03	0.00	0.00	0.00	0.48	0.48
KY	0.11	0.13	0.08	0.05	0.00	0.00	0.00	0.37	0.37
LA	0.82	1.81	3.08	0.51	0.00	0.00	0.00	6.21	6.21
MD	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.03	0.03
MI	0.02	0.04	0.02	0.01	0.00	0.00	0.00	0.09	0.09
MN	0.03	0.10	0.05	0.01	0.00	0.00	0.00	0.19	0.19
MO	0.14	0.15	0.02	0.02	0.00	0.00	0.00	0.34	0.34
MS	0.42	0.48	0.46	0.08	0.00	0.00	0.00	1.45	1.45
NC	0.01	0.02	0.01	0.01	0.00	0.00	0.00	0.05	0.05
NJ	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.04	0.04
NY	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.04	0.04
OH	0.05	0.10	0.04	0.02	0.00	0.00	0.00	0.21	0.21
OK	0.11	0.22	0.22	0.01	0.00	0.00	0.00	0.56	0.56
PA	0.02	0.07	0.01	0.01	0.00	0.00	0.00	0.11	0.11
TN	0.23	0.20	0.07	0.01	0.00	0.00	0.00	0.52	0.52
TX	6.72	11.50	5.94	1.31	0.00	0.00	0.00	25.47	25.47
VA	0.02	0.03	0.01	0.00	0.00	0.00	0.00	0.06	0.06
WI	0.03	0.04	0.02	0.00	0.00	0.00	0.00	0.08	0.08
WV	0.01	0.04	0.01	0.01	0.00	0.00	0.00	0.07	0.07
Other	0.08	2.16	0.41	0.03	0.00	0.00	0.00	2.68	2.68
Can + Mex	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.47	0.00
Natural	0.00	0.00	0.00	0.00	6.26	0.00	0.00	6.26	0.00
ICBC	0.00	0.00	0.00	0.00	0.00	0.00	23.40	23.40	0.00
<b>Total</b>	<b>8.75</b>	<b>16.62</b>	<b>10.21</b>	<b>2.30</b>	<b>5.63</b>	<b>0.42</b>	<b>21.07</b>	<b>72.20</b>	<b>42.07</b>

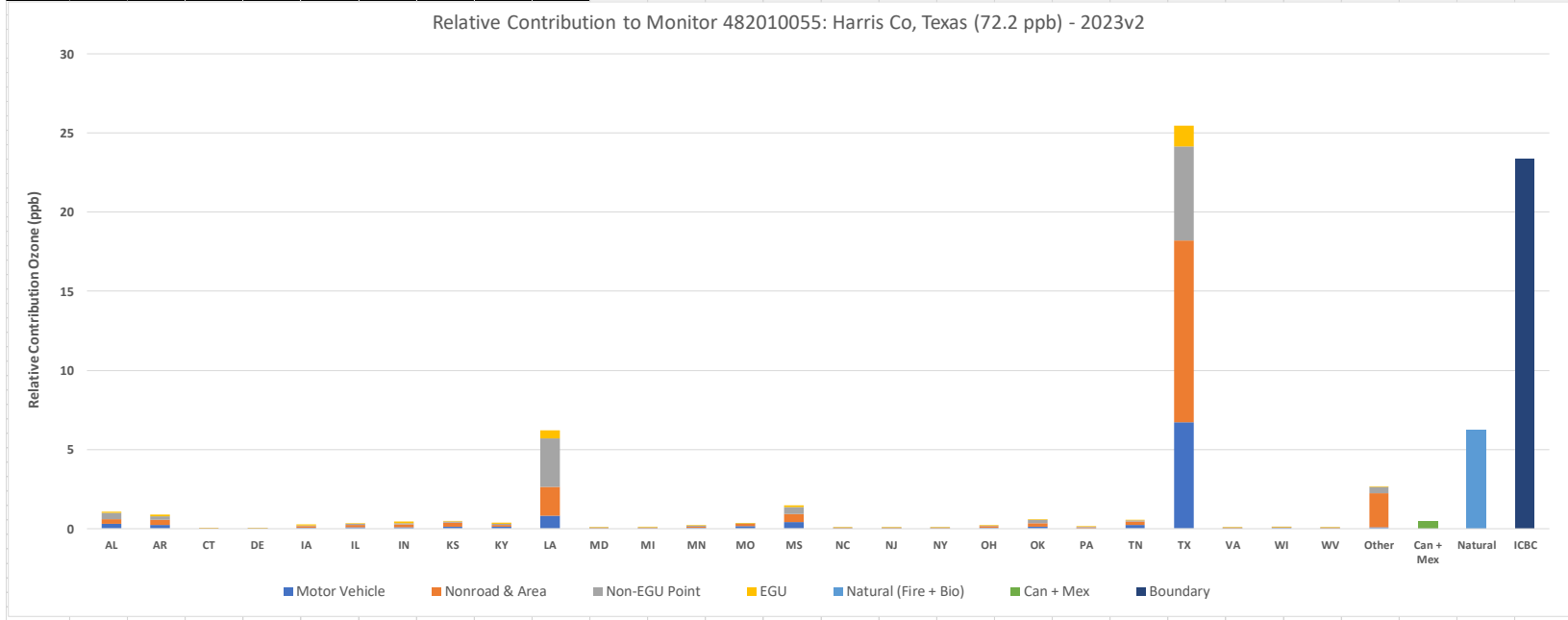
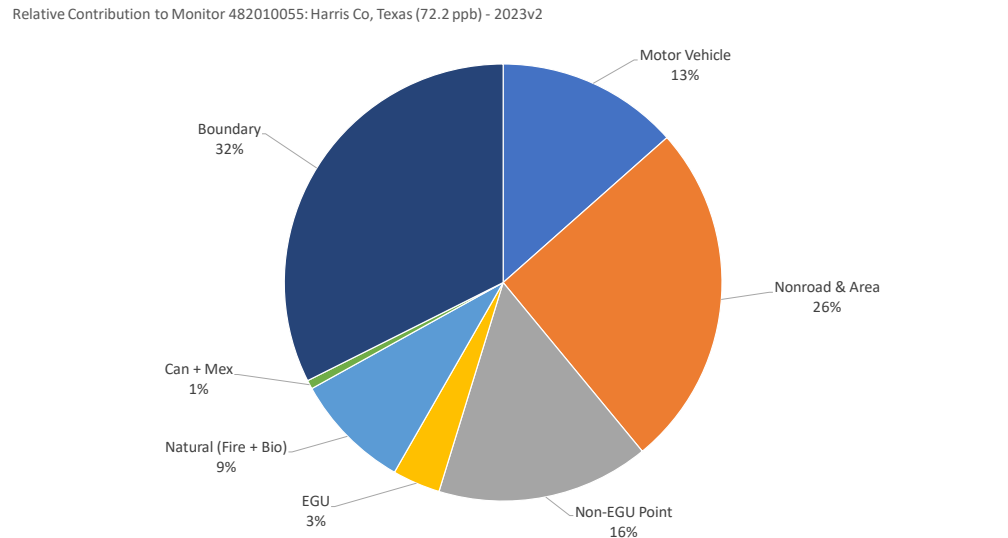
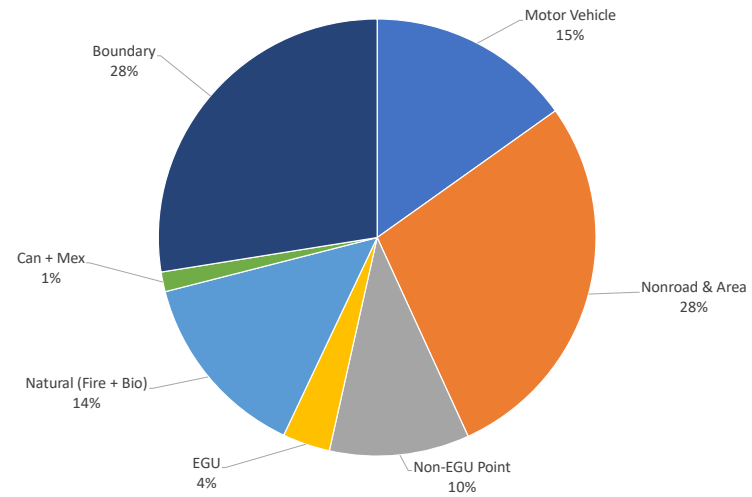


Figure 8. 2023 source apportionment results for Harris Co, TX monitor 482010055 using top 10 future year modeled days.

Monitor	Kenosha Co, Wisconsin				Average 2023 DV (ppb) ->					72.8
State	Motor Vehicle	Nonroad & Area	Non-EGU Point	EGU	Natural (Fire + Bio)	Can + Mex	Boundary	Total	Total Anthro	
AL	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.02	
AR	0.05	0.08	0.03	0.02	0.00	0.00	0.00	0.18	0.18	
CT	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.06	0.06	
DE	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.04	0.04	
IA	0.10	0.17	0.08	0.07	0.00	0.00	0.00	0.43	0.43	
IL	5.70	10.30	2.83	0.73	0.00	0.00	0.00	19.56	19.56	
IN	1.46	1.90	2.09	0.45	0.00	0.00	0.00	5.90	5.90	
KS	0.11	0.23	0.08	0.06	0.00	0.00	0.00	0.48	0.48	
KY	0.18	0.23	0.17	0.05	0.00	0.00	0.00	0.63	0.63	
LA	0.02	0.06	0.07	0.01	0.00	0.00	0.00	0.16	0.16	
MD	0.04	0.07	0.01	0.01	0.00	0.00	0.00	0.13	0.13	
MI	0.33	0.46	0.22	0.15	0.00	0.00	0.00	1.16	1.16	
MN	0.07	0.17	0.14	0.04	0.00	0.00	0.00	0.42	0.42	
MO	0.24	0.30	0.04	0.07	0.00	0.00	0.00	0.66	0.66	
MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	
NC	0.16	0.13	0.07	0.02	0.00	0.00	0.00	0.37	0.37	
NJ	0.06	0.13	0.01	0.01	0.00	0.00	0.00	0.21	0.21	
NY	0.11	0.24	0.03	0.02	0.00	0.00	0.00	0.40	0.40	
OH	0.57	1.13	0.58	0.21	0.00	0.00	0.00	2.49	2.49	
OK	0.10	0.19	0.15	0.04	0.00	0.00	0.00	0.47	0.47	
PA	0.12	0.36	0.08	0.06	0.00	0.00	0.00	0.62	0.62	
TN	0.03	0.03	0.05	0.00	0.00	0.00	0.00	0.11	0.11	
TX	0.24	0.59	0.19	0.09	0.00	0.00	0.00	1.12	1.12	
VA	0.25	0.26	0.13	0.02	0.00	0.00	0.00	0.66	0.66	
WI	0.98	1.44	0.37	0.30	0.00	0.00	0.00	3.09	3.09	
WV	0.07	0.41	0.10	0.11	0.00	0.00	0.00	0.70	0.70	
Other	0.00	1.45	0.00	0.00	0.00	0.00	0.00	1.45	1.45	
Can + Mex	0.00	0.00	0.00	0.00	0.00	1.06	0.00	1.06	0.00	
Natural	0.00	0.00	0.00	0.00	10.18	0.00	0.00	10.18	0.00	
ICBC	0.00	0.00	0.00	0.00	0.00	0.00	20.04	20.04	0.00	
<b>Total</b>	<b>9.95</b>	<b>18.40</b>	<b>6.79</b>	<b>2.31</b>	<b>9.19</b>	<b>0.96</b>	<b>18.08</b>	<b>72.80</b>	<b>41.51</b>	

Relative Contribution to Monitor 550590019: Kenosha Co, Wisconsin (72.8 ppb) - 2023v2



Relative Contribution to Monitor 550590019: Kenosha Co, Wisconsin (72.8 ppb) - 2023v2

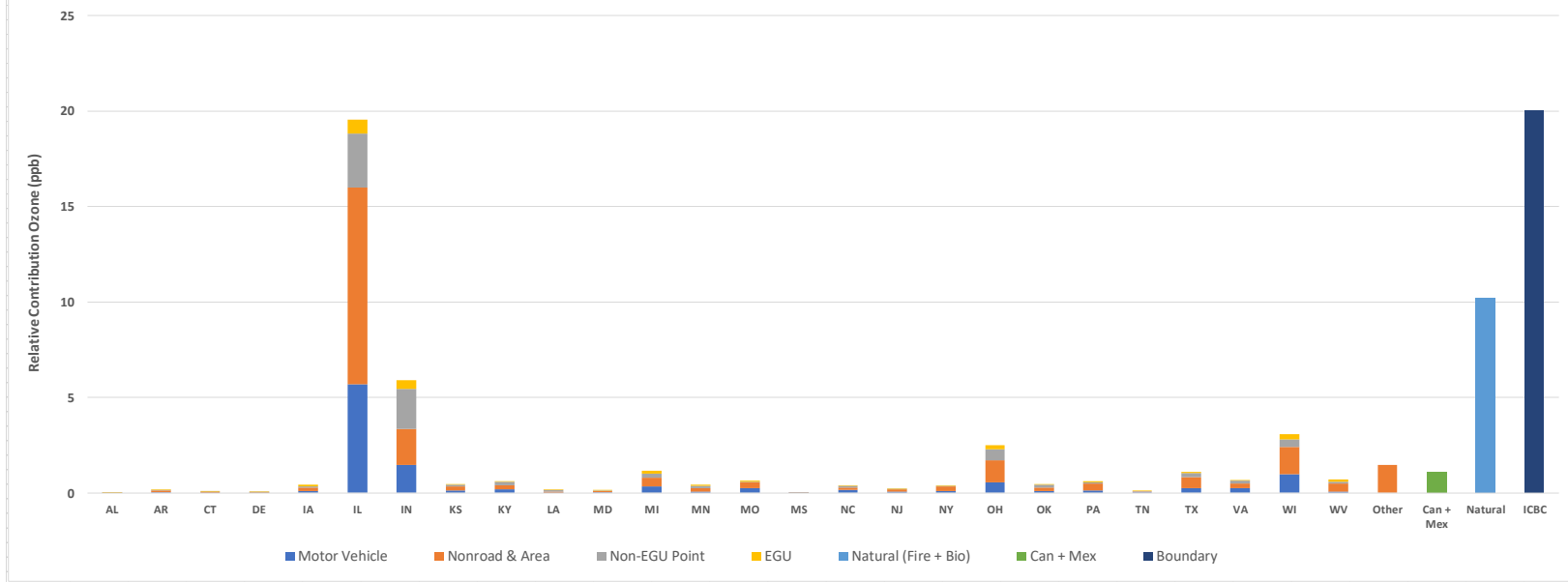
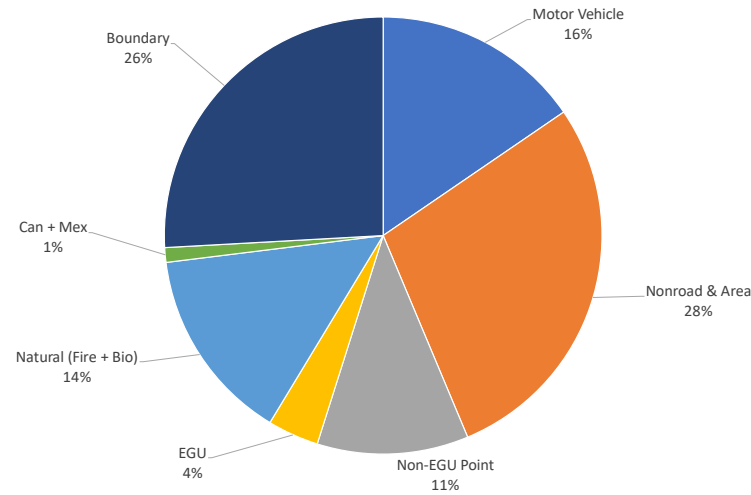


Figure 9. 2023 source apportionment results for Kenosha Co, WI monitor 550590019 using top 10 future year modeled days.

Monitor	551010020				Racine Co, Wisconsin				Average 2023 DV (ppb) ->		71.3
APCA Relative Contribution (ppb) - Scaled to 2023 Avg DV - Future Modeled Days ≥ 60 ppb											
State	Motor Vehicle	Nonroad & Area	Non-EGU Point	EGU	Natural (Fire + Bio)	Can + Mex	Boundary	Total	Total Anthro		
AL	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.02		
AR	0.06	0.10	0.04	0.03	0.00	0.00	0.00	0.23	0.23		
CT	0.02	0.05	0.00	0.01	0.00	0.00	0.00	0.08	0.08		
DE	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.05	0.05		
IA	0.11	0.19	0.08	0.08	0.00	0.00	0.00	0.46	0.46		
IL	4.08	7.20	2.55	0.56	0.00	0.00	0.00	14.39	14.39		
IN	1.33	1.76	2.24	0.50	0.00	0.00	0.00	5.83	5.83		
KS	0.13	0.22	0.08	0.05	0.00	0.00	0.00	0.48	0.48		
KY	0.28	0.27	0.25	0.06	0.00	0.00	0.00	0.87	0.87		
LA	0.02	0.07	0.08	0.01	0.00	0.00	0.00	0.19	0.19		
MD	0.06	0.10	0.02	0.01	0.00	0.00	0.00	0.19	0.19		
MI	0.34	0.48	0.17	0.14	0.00	0.00	0.00	1.13	1.13		
MN	0.08	0.19	0.16	0.05	0.00	0.00	0.00	0.48	0.48		
MO	0.25	0.33	0.05	0.07	0.00	0.00	0.00	0.70	0.70		
MS	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.02		
NC	0.26	0.22	0.07	0.02	0.00	0.00	0.00	0.57	0.57		
NJ	0.07	0.17	0.02	0.02	0.00	0.00	0.00	0.27	0.27		
NY	0.13	0.29	0.04	0.03	0.00	0.00	0.00	0.49	0.49		
OH	0.41	0.76	0.42	0.18	0.00	0.00	0.00	1.77	1.77		
OK	0.10	0.18	0.14	0.03	0.00	0.00	0.00	0.45	0.45		
PA	0.13	0.38	0.08	0.06	0.00	0.00	0.00	0.65	0.65		
TN	0.05	0.04	0.06	0.00	0.00	0.00	0.00	0.15	0.15		
TX	0.24	0.60	0.19	0.10	0.00	0.00	0.00	1.14	1.14		
VA	0.37	0.36	0.16	0.03	0.00	0.00	0.00	0.92	0.92		
WI	2.36	4.41	0.93	0.53	0.00	0.00	0.00	8.24	8.24		
WV	0.10	0.53	0.12	0.13	0.00	0.00	0.00	0.88	0.88		
Other	0.00	1.19	0.00	0.00	0.00	0.00	0.00	1.19	1.19		
Can + Mex	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.77	0.00		
Natural	0.00	0.00	0.00	0.00	10.25	0.00	0.00	10.25	0.00		
ICBC	0.00	0.00	0.00	0.00	0.00	0.00	18.45	18.45	0.00		
<b>Total</b>	<b>10.03</b>	<b>18.34</b>	<b>7.26</b>	<b>2.46</b>	<b>9.34</b>	<b>0.71</b>	<b>16.81</b>	<b>71.30</b>	<b>41.82</b>		

Relative Contribution to Monitor 551010020: Racine Co, Wisconsin (71.3 ppb) - 2023v2



Relative Contribution to Monitor 551010020: Racine Co, Wisconsin (71.3 ppb) - 2023v2

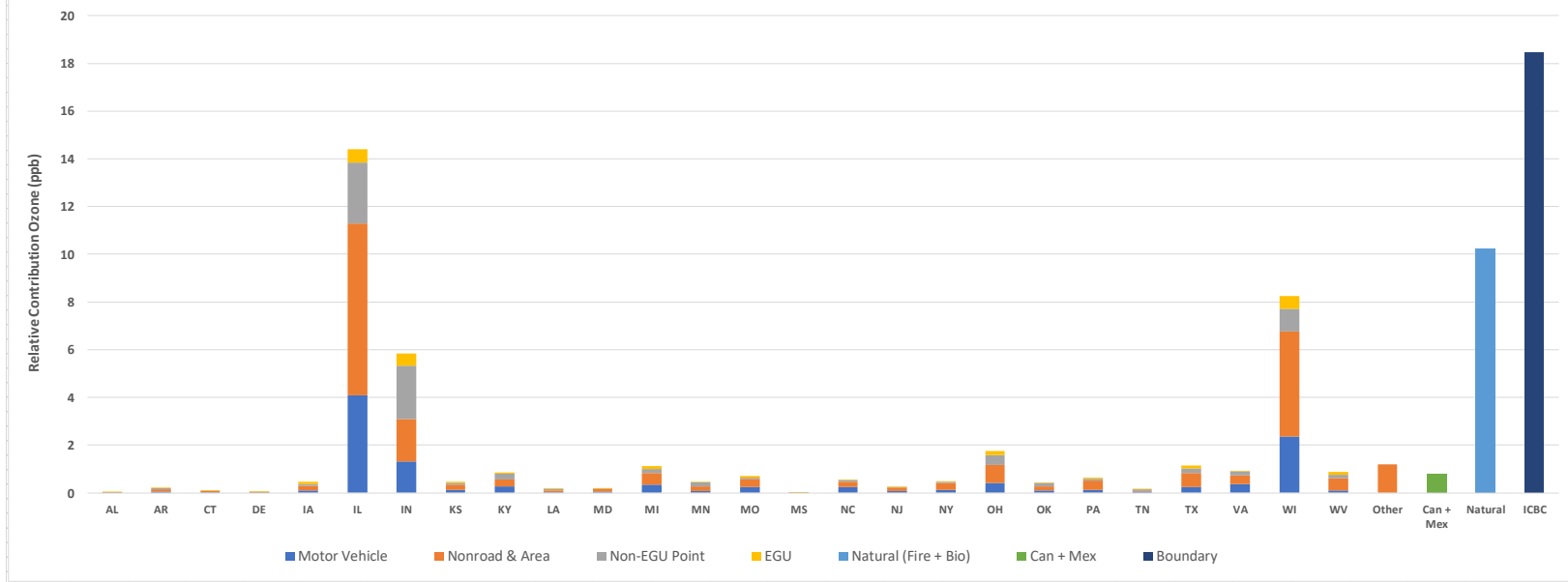


Figure 10. 2023 source apportionment results for Racine Co, WI monitor 551010020 using top 10 future year modeled days.

Monitor	Sheboygan Co, Wisconsin					Average 2023 DV (ppb) ->				
551170006						74.1				
APCA Relative Contribution (ppb) - Scaled to 2023 Avg DV - Future Modeled Days ≥ 60 ppb										
State	Motor Vehicle	Nonroad & Area	Non-EGU Point	EGU	Natural (Fire + Bio)	Can + Mex	Boundary	Total	Total Anthro	
AL	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.06	0.06	
AR	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.04	0.04	
CT	0.03	0.08	0.00	0.01	0.00	0.00	0.00	0.12	0.12	
DE	0.02	0.03	0.01	0.00	0.00	0.00	0.00	0.06	0.06	
IA	0.02	0.04	0.01	0.02	0.00	0.00	0.00	0.09	0.09	
IL	3.64	5.61	2.47	0.56	0.00	0.00	0.00	12.28	12.28	
IN	1.85	2.03	2.44	0.77	0.00	0.00	0.00	7.09	7.09	
KS	0.03	0.08	0.03	0.01	0.00	0.00	0.00	0.15	0.15	
KY	0.35	0.29	0.25	0.02	0.00	0.00	0.00	0.90	0.90	
LA	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.05	0.05	
MD	0.07	0.11	0.01	0.01	0.00	0.00	0.00	0.20	0.20	
MI	0.84	1.29	0.48	0.41	0.00	0.00	0.00	3.02	3.02	
MN	0.06	0.19	0.12	0.03	0.00	0.00	0.00	0.40	0.40	
MO	0.05	0.05	0.01	0.02	0.00	0.00	0.00	0.13	0.13	
MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	
NC	0.34	0.28	0.13	0.02	0.00	0.00	0.00	0.77	0.77	
NJ	0.09	0.22	0.02	0.01	0.00	0.00	0.00	0.34	0.34	
NY	0.22	0.52	0.07	0.05	0.00	0.00	0.00	0.87	0.87	
OH	0.48	0.93	0.59	0.19	0.00	0.00	0.00	2.18	2.18	
OK	0.04	0.08	0.07	0.01	0.00	0.00	0.00	0.20	0.20	
PA	0.20	0.65	0.12	0.07	0.00	0.00	0.00	1.04	1.04	
TN	0.13	0.10	0.17	0.00	0.00	0.00	0.00	0.40	0.40	
TX	0.09	0.23	0.08	0.04	0.00	0.00	0.00	0.44	0.44	
VA	0.31	0.39	0.12	0.02	0.00	0.00	0.00	0.84	0.84	
WI	2.55	4.06	0.65	0.75	0.00	0.00	0.00	8.01	8.01	
WV	0.10	0.46	0.11	0.11	0.00	0.00	0.00	0.77	0.77	
Other	0.12	0.55	0.00	0.09	0.00	0.00	0.00	0.76	0.76	
Can + Mex	0.00	0.00	0.00	0.00	0.00	1.50	0.00	1.50	0.00	
Natural	0.00	0.00	0.00	0.00	7.94	0.00	0.00	7.94	0.00	
ICBC	0.00	0.00	0.00	0.00	0.00	0.00	23.44	23.44	0.00	
<b>Total</b>	<b>10.23</b>	<b>16.07</b>	<b>7.02</b>	<b>2.82</b>	<b>6.96</b>	<b>1.31</b>	<b>20.55</b>	<b>74.10</b>	<b>41.22</b>	

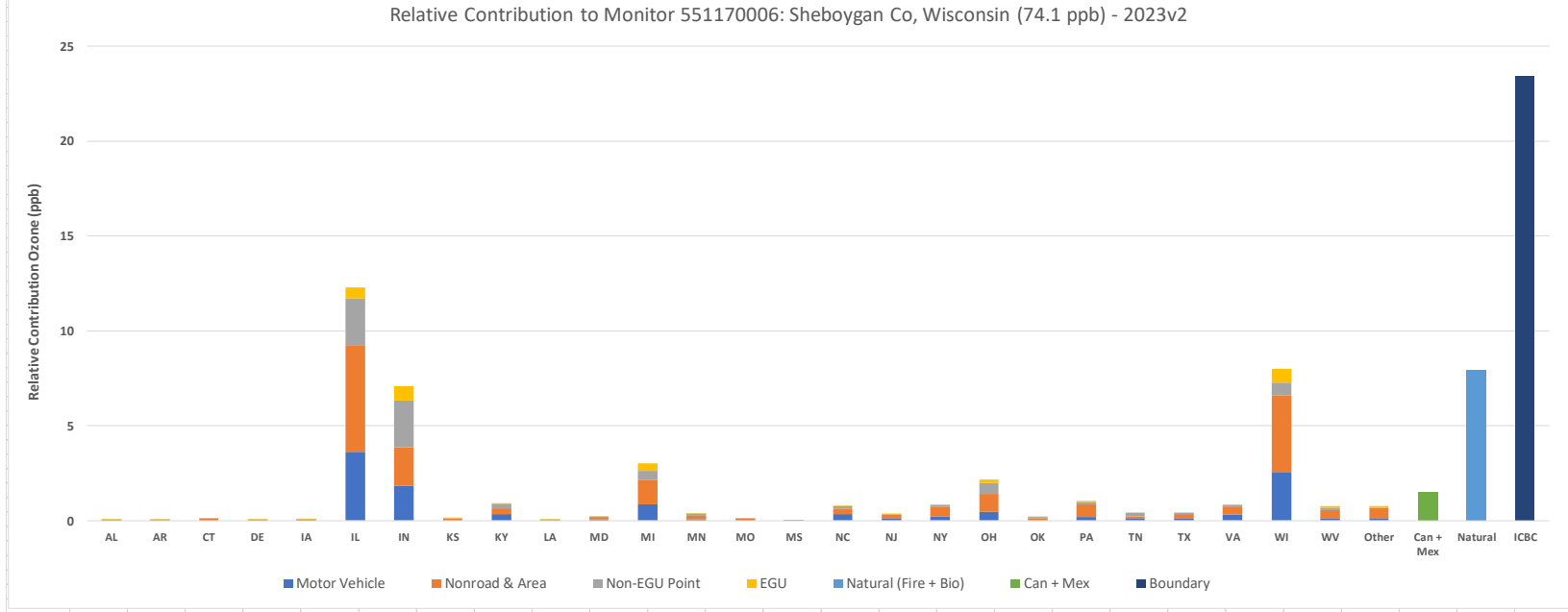
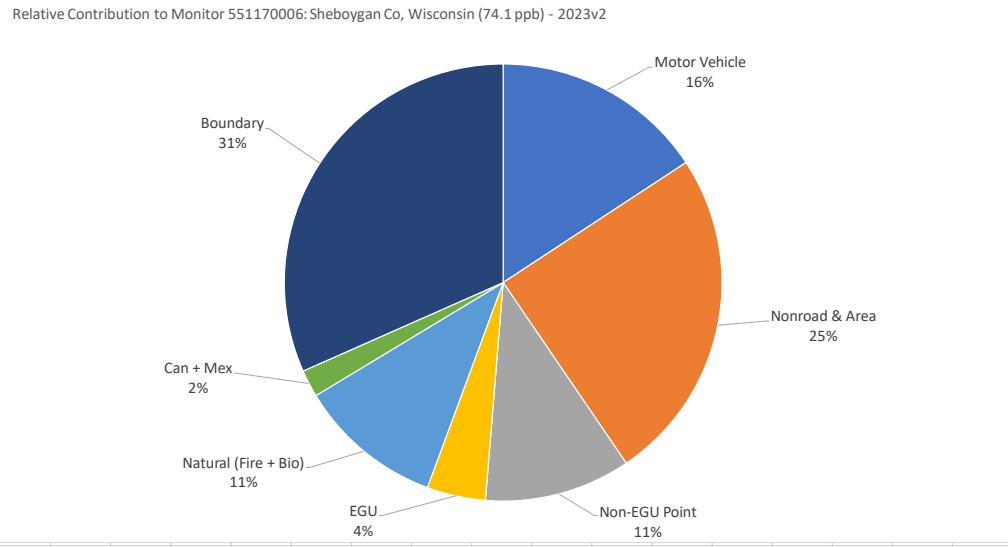


Figure 11. 2023 source apportionment results for Sheboygan Co, WI monitor 551170006 using top 10 future year modeled days.