

## Supplementary material

**Table S1.** Emission factors

Vehicle category	Fuel	CO <sub>2</sub> * (g/kg)	CH <sub>4</sub> ** kgCH <sub>4</sub> /TJ	N <sub>2</sub> O* (g/kg)	CO* (g/kg)	NMVOC* (g/kg)	NO <sub>x</sub> * (g/kg)	SO <sub>2</sub> *** KgSO <sub>2</sub> /TJ	NH <sub>3</sub> * (g/kg)	PM* (g/kg)	BC* (%PM)
Personal cars	Gasoline	3,169	25	0.32	269	34.42	29.89	3.5705	1.106	0.03	0.12
	Gas oil	3,169	3.9	0.107	8.19	1.88	13.88	2.9676	0.065	1.1	0.57
Light commercial vehicles	Gasoline	3,169	25	0.316	283	26.08	25.46	3.5705	0.667	0.02	0.05
	Gas oil	3,169	3.9	0.072	11.71	1.96	18.43	2.9676	0.038	1.52	0.55
Heavy	Gas oil	3,169	3.9	0.089	7.58	3.77	38.29	2.9676	0.013	0.94	0.53
Motorcycle	Gasoline	3,169	25	0.067	664	364.8	10.73	3.5705	0.059	2.2	0.11

\* EMEP/EEA air pollutant emission inventory guidebook 2019 (cita) \*\* 2006 IPCC Guidelines for National Greenhouse Inventories (cita) \*\*\* 2016 UPME FECOC calculator (Colombian fuel emission factors) (Cita). The emission factors provided by the EMEP/EEA database and the IPCC have a 95% confidence interval.

**Table S2.** Quality standard of Gasoline

Normative	Parameter/ validity	Units	Value
Resolution 1190 de 2006	Maximum lead	g/l	April 1, 2021 0.013
			December 31, 2010 0.013
	Aromatics	%vol	April 1, 2001 28
			December 31, 2010 28
	Benzene	%vol	April 1, 2001 1
			December 31, 2010 1
	Sulfur	ppm	July 1, 2007 1000
			December 31, 2010 300
Resolution 40103 de 2021	Maximum lead	g/L	0.013
	Aromatics	%(V/V)	28
	Benzene	%(V/V)	2
	Sulfur	ppm	As of April 20, 2021 300
			As of May 1, 2021 100

As of December 31, 2021	50
As of December 31, 2030	10

**Table S3.** Quality standard of Diesel

<b>Normative</b>	<b>Parameter/ validity</b>		<b>Units</b>	<b>Value</b>
<b>Resolution 1190/2006</b>	Maximum sulfur	As of December 31, 2010	ppm	500
	Maximum aromatics		%vol	35
	Biofuel content, maximum	As of January, 2008	%vol	5
<b>Resolution 9-0963/2014</b>	Maximum sulfur		ppm	50
	Maximum aromatics	As of July 31, 2016	%vol	35
	Biofuel content		%vol	10
<b>Resolution 40103/2021</b>	Maximum sulfur	Until April 30, 2021	ppm	50
		As of May 1, 2021		20
		As of January 1, 2023		15
		As of December, 2025		10
	Aromatic hydrocarbons	Polycyclic aromatic	%(m/m)	8

Table S4. Regional emissions of ozone precursors, acidifying gases and aerosols (Gg)

Regions-pollutant	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	
Andean	CO	668.10	731.64	755.02	785.00	824.96	914.29	994.50	1,001.96	1,033.57	1,087.47	903.10	1,170.11
	NMVOC	56.11	61.67	63.59	65.91	69.08	76.08	82.19	82.70	85.31	89.48	74.45	95.69
	NOx	117.87	131.71	135.29	138.22	143.19	153.00	159.88	159.80	164.82	170.20	143.01	176.31
	SO2	0.49	0.54	0.56	0.57	0.60	0.65	0.69	0.69	0.71	0.74	0.62	0.78
	NH3	1.64	1.80	1.86	1.93	2.03	2.25	2.44	2.46	2.54	2.67	2.22	2.87
	PM	1.90	2.11	2.17	2.22	2.31	2.48	2.61	2.62	2.70	2.80	2.34	2.92
	BC	1.20	1.36	1.39	1.41	1.45	1.51	1.54	1.54	1.58	1.62	1.37	1.63
	Amazon	CO	20.01	23.20	23.45	26.32	28.56	32.59	35.95	36.92	38.24	40.71	40.89
NMVOC		1.87	1.87	1.89	2.13	2.30	2.59	2.85	2.92	3.01	3.21	3.21	4.23
NOx		2.70	3.23	3.20	3.73	3.88	4.07	4.35	4.36	4.42	4.71	4.59	5.90
SO2		0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
NH3		0.05	0.06	0.06	0.06	0.07	0.08	0.09	0.09	0.09	0.10	0.10	0.13
PM		0.05	0.05	0.05	0.06	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.10
BC		0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04
Pacific		CO	162.54	201.44	205.62	214.16	230.53	262.73	294.46	303.48	317.41	333.44	289.89
	NMVOC	13.52	16.83	17.25	17.92	19.19	21.66	24.04	24.69	25.79	27.04	23.61	28.40
	NOx	27.12	34.50	36.07	37.03	38.61	41.66	43.87	44.25	45.89	47.58	42.53	48.73
	SO2	0.11	0.14	0.15	0.15	0.16	0.18	0.19	0.20	0.21	0.21	0.19	0.22
	NH3	0.40	0.50	0.51	0.53	0.57	0.65	0.72	0.75	0.78	0.82	0.71	0.86
	PM	0.44	0.56	0.58	0.60	0.63	0.68	0.73	0.74	0.77	0.80	0.71	0.82
	BC	0.27	0.35	0.37	0.37	0.38	0.40	0.40	0.40	0.41	0.42	0.39	0.42
	Caribbean	CO	134.07	142.44	155.87	167.93	189.47	232.45	274.81	281.43	299.44	328.99	288.80

Orinoquia	NM VOC	11.84	12.68	13.65	14.64	16.30	19.74	22.99	23.40	24.92	27.25	23.99	31.93
	NO <sub>x</sub>	30.40	33.46	34.03	35.90	37.92	43.57	47.44	46.86	50.14	53.60	47.85	60.64
	SO <sub>2</sub>	0.12	0.13	0.13	0.14	0.15	0.18	0.20	0.20	0.21	0.23	0.20	0.26
	NH <sub>3</sub>	0.33	0.35	0.38	0.41	0.47	0.57	0.68	0.69	0.74	0.81	0.71	0.95
	PM	0.47	0.52	0.53	0.56	0.60	0.69	0.77	0.76	0.81	0.87	0.78	1.00
	BC	0.35	0.39	0.38	0.40	0.41	0.46	0.48	0.46	0.50	0.52	0.47	0.58
	CO	36.18	42.18	44.46	47.13	50.52	58.75	63.27	62.58	64.21	71.39	70.68	89.28
	NM VOC	3.23	3.84	4.06	4.28	4.57	5.14	5.43	5.36	5.47	6.10	5.96	7.45
	NO <sub>x</sub>	8.62	10.95	11.64	12.06	12.71	12.79	12.47	12.30	12.25	13.83	12.73	15.22
	SO <sub>2</sub>	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.06
	NH <sub>3</sub>	0.09	0.10	0.11	0.12	0.12	0.14	0.16	0.15	0.16	0.18	0.17	0.22
	PM	0.13	0.17	0.18	0.18	0.19	0.20	0.20	0.19	0.19	0.22	0.20	0.25
	BC	0.10	0.13	0.14	0.14	0.15	0.14	0.13	0.13	0.13	0.15	0.13	0.15