

## *Supporting Information for*

### **A mass balance-based emission inventory of non-methane volatile organic compounds (NMVOCs) for solvent use in China**

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Text S1. Source profiles used in this study.

Source profiles of solvents use used in this study are obtained by combining the domestic and foreign profiles. The procedure involves four steps. Firstly, a new domestic profile is formed by calculating the average weight percentage of NMVOCs groups from multiple domestic source profiles. If some source profiles have OVOC, the treatment of OVOC is similar to Wu and Xie (2017) and Li et al. (2014). Secondly, common species in the domestic and foreign profiles were identified, respectively. Common species may account for different proportions in domestic and foreign profiles. Thirdly, we calculate proportions of common species in domestic profiles scaling to proportions of common species in foreign profiles. At the same time, we scale unique species in domestic profiles with the same factor that used in common species from domestic profile to foreign profiles. Lastly, we integrated proportions of common species, unique species in domestic profiles and unique species in foreign profiles into a new and complete source profile. Figure S3-S12 show procedure of source profiles for architectural coating, furniture coating, automobile coating, other coating, offset printing ink, letterpress printing ink, gravure printing ink, other printing ink, shoemaking adhesive and herbicide.

**Table S1 Data source for VOC content of coating (%).**

Products	Jiangsu	Shandong	Zhejiang	Guangdong	Shanghai	Beijing	GB18582-2008	GB24408-2009	Mean
Architectural coating	Solvent-based							68	71
								70	
								76	
	Water-based						12	12 15	13
Furniture coating	Solvent-based	80	65	75	66	60			69
				80	50				
	Water-based	15	10	30	14	5			15
	UV		10		14				12
Automotive coating	Solvent-based	80	45	45	50	45			61
			80	80	45	80			
			55	55	80	55			
	Water-based				55				14
		15			5				
					15				
	UV		10		14				12
Powder coating		0	0	2					1
			0						
			5						
Other coating	Solvent-based	80	70	65	70	65			67
				60	40				
	Water-based	15	10	30					18
	UV		10		14				12

a. GB18582-2008, *Limit of harmful substances of interior architectural coatings*; b. GB24408-2009, *Limit of harmful substances of exterior wall coatings*.

**Table S2 Data source for VOC content of ink (%)**

Products		Jiangsu	Zhejiang	Guangdong	Shanghai	BJX <sup>a</sup>	HJ 2542-2016 <sup>b</sup>	Mean
Offset ink	Sheet-fed offset Ink	5	5	5	5	2	3	4
	Cold set web-fed-offset ink			5		2	3	3
	Heat set web-fed-offset ink	30	30	30	30	5	10	23
Letterpress ink	Solvent-based	60	60	60	60	60		60
	Water-based	15				10		13
Gravure ink	Solvent-based	60	60	60	60	75		63
	Water-based	15				30		23
UV ink		0				2		1
Screen ink		45	45	45	45	50		46
Other ink		60	60	60	60			60

a. Data from VOCs.BJX (2019)

b. HJ 2542-2016, *Technical requirement for environmental labelling products offset printing ink*.

**Table S3. Data source for VOC content of adhesive (%)****Table S3a VOCs content of water-based adhesive**

Application fields	Water-based (%) <sup>a</sup>							Mean
	Polyvinyl acetate	Polyvinyl alcohol	Rubber	Polyurethane	EAV	Acrylics	Other	
Architecture	10	10	15	10	5	10	5	9
Packaging and labelling	5		5	5	5	5	5	5
Woodworking	10		10	5	5	5	5	7
Paper converting	5	5	5	5	5	5	5	5
Shoemaking	5		15	5	5	10	5	8
Fiber processing	5	5	5	5	5	5	5	5
Transportation	5		5	5	5	5	5	5
Residential use	5	5	5	5	5	5	5	5
Other	5	5	5	5	5	5	5	5

a. Data from GB33372-2020, *Limit of volatile organic compounds content in adhesive*.

**Table S3b VOCs content of solvent-based adhesive**

Application fields	Solvent-based (%) <sup>a</sup>					Mean
	Polychloroprene rubber	SBS resin	Polyurethane	Acrylics	Other	
Architecture	65	55	50	51	50	54
Packaging and labelling	60	50	40	51	50	50
Woodworking	60	50	40	51	40	48
Paper converting	60	50	25	51	25	42
Shoemaking	60	50	40		40	48
Fiber processing	60	50	25	51	25	42
Transportation	60	50	25	51	25	42
Residential use	60	50	25	51	25	42
Other	60	50	25	51	25	42

**Table S3c VOCs content of bulk form adhesive**

Application fields	Bulk form (%) <sup>a</sup>									Mean
	Organic silicon	MS	Polyurethane	Polysulfide	Acrylics	Epoxy resins	$\alpha$ -Cyanoacrylate	Thermoplastic	Other	
Architecture	10	10	5	5		10	2	5	5	7
Packaging and labelling	10	5	5					5	5	6
Woodworking	10	5	5	5	20	5	2	5	5	7
Paper converting		5	5					5	5	5
Shoemaking		5	5				2	5	5	4
Fiber processing		5	5					5	5	5
Transportation	10	10	5	5	20	10	2	5	5	8
Residential use	10	5	5	5	20	5	2	5	5	7
Other	10	5	5	5	20	5	2	5	5	7

**Table S4. Data source for VOC content of cleaner and insecticide (%).**

Products			VOC limit (%)	References	Mean
Laundry	Fabric refresher	Aerosol	15	CARB	16
		Nonaerosol	6		
	Fabric protectant	Aerosol	60		
		Nonaerosol	1		
	Laundry prewash	Aerosol/Solid	22		
		All other forms	5		
	Spot remover	Aerosol	15		
		Nonaerosol	3		
Dishwashing			10	HSECSM	10
Surface cleaners	Glass cleaner	Aerosol	10	CARB	9
		Nonaerosol	3		
	Oven or grill cleaner	Aerosol/Pump spray	8		
		Liquid	5		
		Nonaerosol	4		
	Toilet or urinal care product	Aerosol	10		
		Nonaerosol	3		
	Bathroom and tile cleaner	Aerosol	7		
		Nonaerosol	1		
	Oil stain cleaner				
Industrial detergent	Water-based	5	GB 38508-2020 <sup>a</sup>	5	
	Solvent-based	90		90	
Insecticide	Liquid	25	HSECSM	24	
	Spray	22			

a. GB 38508-2020, *Limits for volatile organic compounds content in cleaning agents*

**Table S5. Data source for VOC content of personal care (%) .**

Products			VOC limit (%)	References	Mean
Hair and body care	Hair mousse		6	CARB	23
	Hair shine		55		
	Hair finishing spray		55		
	Hair styling product	Aerosol and pump spray	6		
		All other forms	2		
	Temporary hair color		55		
	Hand cleaner		8		
	Shampoo <sup>a</sup>		8		
	Body wash <sup>a</sup>		8		
Perfumes	With 20% or less fragrance	75	CARB	70	
	With more than 20% fragrance	65			
Skin care			35	Green Seal	35
Other cosmetic	Antiperspirant	Aerosol	50	CARB	18
		Nonaerosol	0		
	Deodorant	Aerosol	10		
		Nonaerosol	0		
	Shaving cream		5		
	Shaving gel		4		
	Nail polish remover		1		
	Nail polish		75		

a. VOC content of shampoo and body wash is referred from data of hand cleaner.



**Table S6. The parameters for calculating emission of various solvent product.**

Products			$W_{VOC}$ (%)	$f_{VOC}$	$f_{S/IVOC}$	$W_{S/IVOC}$ (%)	$VF_{VOC}$	$VF_{S/IVOC}$
Level 1	Level 2	Level 3						
Coating <sup>a</sup>	Architectural coating	Solvent-based	$71 \pm 3$	0.99	0.01	$1 \pm 0$	1	$0.70 \pm 0.20$
		Water-based	$13 \pm 1$	0.76	0.24	$4 \pm 0$	1	$0.70 \pm 0.20$
	Furniture coating	Solvent-based	$69 \pm 10$	0.99	0.01	$1 \pm 0$	1	$0.70 \pm 0.20$
		Water-based	$15 \pm 8$	0.76	0.24	$5 \pm 3$	1	$0.70 \pm 0.20$
		UV	$12 \pm 2$	0.76	0.24	$4 \pm 1$	1	$0.70 \pm 0.20$
	Automotive coating	Solvent-based	$61 \pm 15$	0.99	0.01	$1 \pm 0$	1	$0.70 \pm 0.20$
		Water-based	$14 \pm 5$	0.76	0.24	$4 \pm 1$	1	$0.70 \pm 0.20$
		UV	$12 \pm 2$	0.76	0.24	$4 \pm 1$	1	$0.70 \pm 0.20$
	Powder coating		$1 \pm 2$	0.76	0.24	$0 \pm 0$	1	$0.70 \pm 0.20$
	Other	Solvent-based	$67 \pm 11$	0.99	0.01	$1 \pm 0$	1	$0.70 \pm 0.20$
		Water-based	$18 \pm 8$	0.76	0.24	$6 \pm 3$	1	$0.70 \pm 0.20$
		UV	$12 \pm 2$	0.76	0.24	$4 \pm 1$	1	$0.70 \pm 0.20$
Ink <sup>b</sup>	Offset ink	Sheet-fed offset Ink	$4 \pm 1$	0.86	0.14	$1 \pm 0$	1	$0.70 \pm 0.20$
		Cold set web-fed-offset ink	$3 \pm 1$	0.86	0.14	$0 \pm 0$	1	$0.70 \pm 0.20$
		Heat set web-fed-offset ink	$23 \pm 11$	0.86	0.14	$4 \pm 2$	1	$0.70 \pm 0.20$
	Letterpress ink	Solvent-based	$60 \pm 0$	0.86	0.14	$10 \pm 0$	1	$0.70 \pm 0.20$
		Water-based	$13 \pm 3$	0.86	0.14	$2 \pm 0$	1	$0.70 \pm 0.20$
	Gravure ink	Solvent-based	$63 \pm 6$	0.86	0.14	$10 \pm 1$	1	$0.70 \pm 0.20$
		Water-based	$23 \pm 8$	0.86	0.14	$4 \pm 1$	1	$0.70 \pm 0.20$
	UV ink		$1 \pm 1$	0.86	0.14	$0 \pm 0$	1	$0.70 \pm 0.20$
	Screen ink		$46 \pm 2$	0.86	0.14	$7 \pm 0$	1	$0.70 \pm 0.20$
	Other		$60 \pm 0$	0.86	0.14	$10 \pm 0$	1	$0.70 \pm 0.20$
Adhesive <sup>c</sup>	Architecture	Water-based	$9 \pm 3$	0.86	0.14	$1 \pm 1$	1	$0.70 \pm 0.20$
		Solvent-based	$54 \pm 6$	0.89	0.11	$7 \pm 1$	1	$0.70 \pm 0.20$

Products			$W_{VOC}$ (%)	$f_{VOC}$	$f_{S/IVOC}$	$W_{S/IVOC}$ (%)	$VF_{VOC}$	$VF_{S/IVOC}$
Level 1	Level 2	Level 3						
	Residential use	Bulk form	$7 \pm 3$	0.86	0.14	$1 \pm 0$	1	$0.70 \pm 0.20$
		Water-based	$5 \pm 0$	0.86	0.14	$1 \pm 0$	1	$0.70 \pm 0.20$
		Solvent-based	$42 \pm 14$	0.89	0.11	$5 \pm 2$	1	$0.70 \pm 0.20$
		Bulk form	$7 \pm 5$	0.86	0.14	$1 \pm 1$	1	$0.70 \pm 0.20$
	Woodworking	Water-based	$7 \pm 2$	0.86	0.14	$1 \pm 0$	1	$0.70 \pm 0.20$
		Solvent-based	$48 \pm 8$	0.89	0.11	$6 \pm 1$	1	$0.70 \pm 0.20$
		Bulk form	$7 \pm 5$	0.86	0.14	$1 \pm 1$	1	$0.70 \pm 0.20$
		Formaldehyde type	$5 \pm 4^d$	0.86	0.14	$1 \pm 1$	1	$0.70 \pm 0.20$
	Paper converting	water-based	$5 \pm 0$	0.86	0.14	$1 \pm 0$	1	$0.70 \pm 0.20$
		Solvent-based	$42 \pm 14$	0.89	0.11	$5 \pm 2$	1	$0.70 \pm 0.20$
		Bulk form	$5 \pm 0$	0.86	0.14	$1 \pm 0$	1	$0.70 \pm 0.20$
	Shoemaking	Water-based	$8 \pm 4$	0.86	0.14	$1 \pm 1$	1	$0.70 \pm 0.20$
		Solvent-based	$48 \pm 8$	0.89	0.11	$6 \pm 1$	1	$0.70 \pm 0.20$
		Bulk form	$4 \pm 1$	0.86	0.14	$1 \pm 0$	1	$0.70 \pm 0.20$
	Fiber processing	Water-based	$5 \pm 0$	0.86	0.14	$1 \pm 0$	1	$0.70 \pm 0.20$
		Solvent-based	$42 \pm 14$	0.89	0.11	$5 \pm 2$	1	$0.70 \pm 0.20$
		Bulk form	$5 \pm 0$	0.86	0.14	$1 \pm 0$	1	$0.70 \pm 0.20$
	Transportation	Water-based	$5 \pm 0$	0.86	0.14	$1 \pm 0$	1	$0.70 \pm 0.20$
		Solvent-based	$42 \pm 14$	0.89	0.11	$5 \pm 2$	1	$0.70 \pm 0.20$
		Bulk form	$8 \pm 5$	0.86	0.14	$1 \pm 1$	1	$0.70 \pm 0.20$
	Packaging and labelling	Water-based	$5 \pm 0$	0.86	0.14	$1 \pm 0$	1	$0.70 \pm 0.20$
		Solvent-based	$50 \pm 6$	0.89	0.11	$6 \pm 1$	1	$0.70 \pm 0.20$
		Bulk form	$6 \pm 2$	0.86	0.14	$1 \pm 0$	1	$0.70 \pm 0.20$
	Other	Water-based	$5 \pm 0$	0.86	0.14	$1 \pm 0$	1	$0.70 \pm 0.20$
		Solvent-based	$42 \pm 14$	0.89	0.11	$5 \pm 2$	1	$0.70 \pm 0.20$

Products			$W_{VOC}$ (%)	$f_{VOC}$	$f_{S/IVOC}$	$W_{S/IVOC}$ (%)	$VF_{VOC}$	$VF_{S/IVOC}$
Level 1	Level 2	Level 3						
		Bulk form	$7 \pm 5$	0.86	0.14	$1 \pm 1$	1	$0.70 \pm 0.20$
Pesticide	Insecticide		$24 \pm 2$	0.5	0.5	$24 \pm 2$	1	$0.30 \pm 0.25$
	Herbicide		$24 \pm 2^f$	0.5	0.5	$24 \pm 2$	1	$0.30 \pm 0.25$
	Bactericide		$24 \pm 2^f$	0.5	0.5	$24 \pm 2$	1	$0.30 \pm 0.25$
	Other		$24 \pm 2^f$	0.5	0.5	$24 \pm 2$	1	$0.30 \pm 0.25$
Cleaner	Laundry		$16 \pm 18$	0.81	0.19	$4 \pm 4$	$0.007 \pm 0.005$	0
	Dishwashing		$10 \pm 0$	0.92	0.08	$1 \pm 0$	$0.044 \pm 0.006$	0
	Surface cleaner		$9 \pm 11$	0.78	0.22	$3 \pm 4$	$0.47 \pm 0.38$	0
	Industrial detergent <sup>e</sup>	Water-based	$5 \pm 0$	0.22	0.78	$18 \pm 0$	0.25	0.25
		Solvent-based	$90 \pm 0$	0.99	0.01	$1 \pm 0$	1	$0.70 \pm 0.20$
Personal care	Hair and body care		$23 \pm 23$	0.91	0.09	$2 \pm 2$	$0.60 \pm 0.40$	0
	Perfume		$70 \pm 5$	0.78	0.22	$20 \pm 1$	1	$0.40 \pm 0.15$
	Skin care		$35 \pm 0$	0.93	0.07	$3 \pm 0$	1	$0.40 \pm 0.15$
	Other		$18 \pm 27$	0.86	0.14	$3 \pm 4$	$0.80 \pm 0.20$	$0.40 \pm 0.15$

a. The total of coating activity comes from China coating industry Yearbook. Level 2 of coating are derived from the China Coating Industry Yearbook for 2007-2010 and the "13th Five-Year plan" of China coating industry for 2011-2014. Level 3 of architectural coating is from Liu (2000) for 2000, China coating industry Yearbook for 2007-2010, Chyxx (2014) for 2013 and Huaon (2019) for 2018. Years missing data are estimated based on the most recent years data available for level 2 and 3. Level 3 of other coating are estimated roughly based on water-based, solvent-based and UV proportion in total.

b. The total and level 2 of ink are obtained from China Light Industry Yearbook. Level 3 proportion for some ink are from Chyxx (2017), Bai and Zi (2003) and Qianzhan (2019).

c. The total and level 2 sources of adhesive are obtained from China Chemical Industry Yearbook. Solvent-based proportion of shoemaking adhesive is from Yuan and Chen (2005) and Chyxx (2015). Other level 3 are estimated roughly based on water-based, solvent-based and bulk form proportion in total.

d. VOCs content of formaldehyde type adhesive is referred to DYQ (2019), Henan River Grinding Material Co LTD (2020) and GB/T14732—2017 (*Wood adhesive: urea-formaldehyde, phenol-formaldehyde and melamine-formaldehyde resins*).

e. Level 3 of industrial detergent is from Vzko (2019).

f. Data are referred to that of insecticide.

**Table S7. Proxy variables for allocating national emissions to provincial level.**

Solvent use		Proxy variable
Pesticide		Cultivated land area <sup>a</sup>
Personal care		Disposable income of households <sup>a</sup>
Cleaner	Industrial detergent	Industrial sales value <sup>b</sup>
	Other cleaner	Disposable income of households <sup>a</sup>
Coating	Architectural coating	Building area completed <sup>a</sup>
	Automotive coatings	Sales value of automobile manufacturing <sup>b</sup>
	Furniture coatings	Sales value of furniture manufacturing <sup>b</sup>
	Other coatings	Industrial sales value <sup>b</sup>
Ink		Sales value of printing and recording media reproduction industry <sup>b</sup>
Adhesive	adhesives for wood processing	Sales value of wood processing <sup>b</sup>
	Adhesives for paper processing, label	Sales value of printing and recording media reproduction industry <sup>b</sup>
	Adhesives for fiber processing	Sales value of fiber processing <sup>b</sup>
	Adhesives for transportation	Sales value of automobile manufacturing <sup>b</sup>
	Adhesives for building	Building area completed <sup>a</sup>
	Adhesives for making shoes	Sales value of making shoes <sup>b</sup>
	Adhesives for residential use	Disposable income of households <sup>a</sup>
	Other adhesives	Industrial sales value <sup>b</sup>

a. Data from 2017 China Statistical Yearbook

b. Data from 2017 China Industry Statistical Yearbook

**Table S8 (a) Market share of NMVOCs control technologies and their control efficiency in the Yangtze River Delta (YRD) region (Lu et al., 2018).**

VOCs control technology	Share (%)	Control efficiency (%)
Adsorption	48.8	45
Absorption	19.5	20
Plasma	10.3	30
Direct catalytic combustion	7.1	70
Adsorption - Catalytic combustion	6.3	63
Combustion	3.7	78
Photolysis	1.9	15
Other technologies	2.5	43 <sup>a</sup>

**Table S8 (b): Market share of NMVOCs control technologies and their control efficiency in the Pearl River Delta (PRD) region, China (Cai, 2016)**

VOCs control technology	Share (%)	Control efficiency (%)
Adsorption	68	45 <sup>b</sup>
Combination technologies <sup>c</sup>	12	63 <sup>d</sup>
Absorption	11	20 <sup>b</sup>
Combustion	2	78 <sup>b</sup>
Plasma	2	30 <sup>b</sup>
Photolysis	1	15 <sup>b</sup>
Other technologies	3	43 <sup>b</sup>

- a. Control efficiency of other technologies is based on mean of control efficiency of single technology in Table S8 (a)
- b. Data are referred to Table S8 (a).
- c. Combination technologies means that more than two technologies work together to process VOCs
- d. Data is referred to that of adsorption - catalytic combustion in Table S8 (a).

**Table S9. Annual value of production for organic exhaust gas treatment industry, percentage with NMVOCs treatment facilities and effective control efficiency during 2000-2017.**

Year	Annual value of production (Billion CNY)	Percentage with treatment facilities (%)	Overall effective control efficiency (%)
2000	0.49	0	0
2001	0.56	1	0.4
2002	0.64	2	0.9
2003	0.74	3	1.3
2004	0.85	4	1.7
2005	0.98	5	2.2
2006	1.13	6	2.6
2007	1.3	7	3.0
2008	1.5	8	3.4
2009	1.75	9	3.9
2010	2.1	10	4.3
2011	2.8	13.3	5.7
2012	3.2	16.7	7.2
2013	3.5	20	8.6
2014	8.35	35	15.1
2015	21.2	50	21.5
2016	27	60	25.8
2017	54	70	30.1

**Table S10. Solvent use emissions from various categories in 2000-2017 (Tg).**

Year	Adhesive	Coating	Ink	Personal Care	Pesticide	Cleaner	Total	Lower limit	Upper limit
2000	0.30	0.80	0.06	0.35	0.05	0.01	1.58	1.19	2.22
2001	0.32	0.76	0.07	0.44	0.06	0.01	1.66	1.24	2.38
2002	0.38	0.81	0.08	0.49	0.07	0.01	1.85	1.38	2.68
2003	0.44	0.91	0.08	0.66	0.09	0.02	2.19	1.60	3.32
2004	0.47	1.10	0.09	0.70	0.16	0.02	2.53	1.89	3.72
2005	0.52	1.47	0.09	0.75	0.21	0.02	3.06	2.31	4.43
2006	0.65	1.81	0.10	0.77	0.30	0.02	3.65	2.79	5.14
2007	0.78	2.54	0.11	0.87	0.40	0.01	4.71	3.57	6.56
2008	0.83	2.73	0.12	0.99	0.46	0.02	5.14	3.88	7.17
2009	0.97	3.06	0.16	1.04	0.56	0.03	5.82	4.47	7.90
2010	1.20	3.92	0.16	1.09	0.55	0.03	6.96	5.28	9.41
2011	1.40	4.29	0.18	1.26	0.59	0.04	7.76	5.88	10.61
2012	1.49	4.96	0.19	1.47	0.85	0.04	9.00	6.76	12.60
2013	1.63	4.97	0.20	1.68	0.68	0.04	9.19	6.83	13.06
2014	1.65	6.13	0.19	1.77	0.84	0.06	10.64	7.82	14.96
2015	1.62	5.77	0.18	1.87	0.83	0.07	10.34	7.65	14.57
2016	1.65	5.77	0.18	2.10	0.77	0.07	10.53	7.72	14.84
2017	1.63	6.10	0.18	2.15	0.43	0.06	10.55	7.73	14.94

**Table S11. Major policies for NMVOCs control in China.**

Year	Policy	Related content and significance
2010	<i>Notice on promoting joint prevention and control of air pollution and improving regional air quality</i>	VOCs included in the focus of prevention and control
2011	<i>The 12th five-year plan for environmental protection</i>	Strengthening VOCs control
2012	<i>The 12th five-year plan for the prevention and control of air pollution in key regions</i>	The prevention and control of VOCs fully implemented in 2015
2013	<i>The action plan for air pollution prevention and control</i>	Comprehensive VOCs improvement in the petrochemical industry
2015	<i>Law of the People's Republic of China on the prevention and control of air pollution</i>	VOCs prevention and control subject to legal supervision
2016	<i>The 13th five-year plan for ecological and environmental protection</i>	China's total emissions in 2020 dropping by more than 10 percent compared with 2015
2017	<i>The 13th five-year plan for the prevention and control of volatile organic matter pollution</i>	Perfecting the management system for the prevention and control of VOCs pollution by 2020
2018	<i>Three-Year action plan for winning the blue sky defense battle</i>	Implement VOCs special rectification plan



**Table S12. Source classification of NMVOC emissions in MEIC and the adjusted classification in this study.**

MEIC		MEIC adjusted in this study	
Solvent	Solvent use	Solvent	Solvent use
<b>Transportation</b>	Transportation	<b>Transportation</b>	Transportation
<b>Industrial</b>	Coal consumption	<b>Industrial process</b>	Chemical industry
	Other fuel consumption		Oil production, distribution and refinery
	Chemical industry		Other industrial process
	Oil production, distribution and refinery		
	Other industrial process		
<b>Residential</b>	Coal	<b>Combustion</b>	Power
	Wood		Coal-residential
	Crop residuel		Wood-residential
	Waste treatment		Crop residual-residential
	Other fuel consumption		Waste treatment-residential
			Other fuel consumption-residential
<b>Power</b>			Coal consumption-industrial
			Other fuel consumption-industrial

**Table S13. Source categories, emission factors and activity data source for solvent use NMVOC emissions in different studies.**

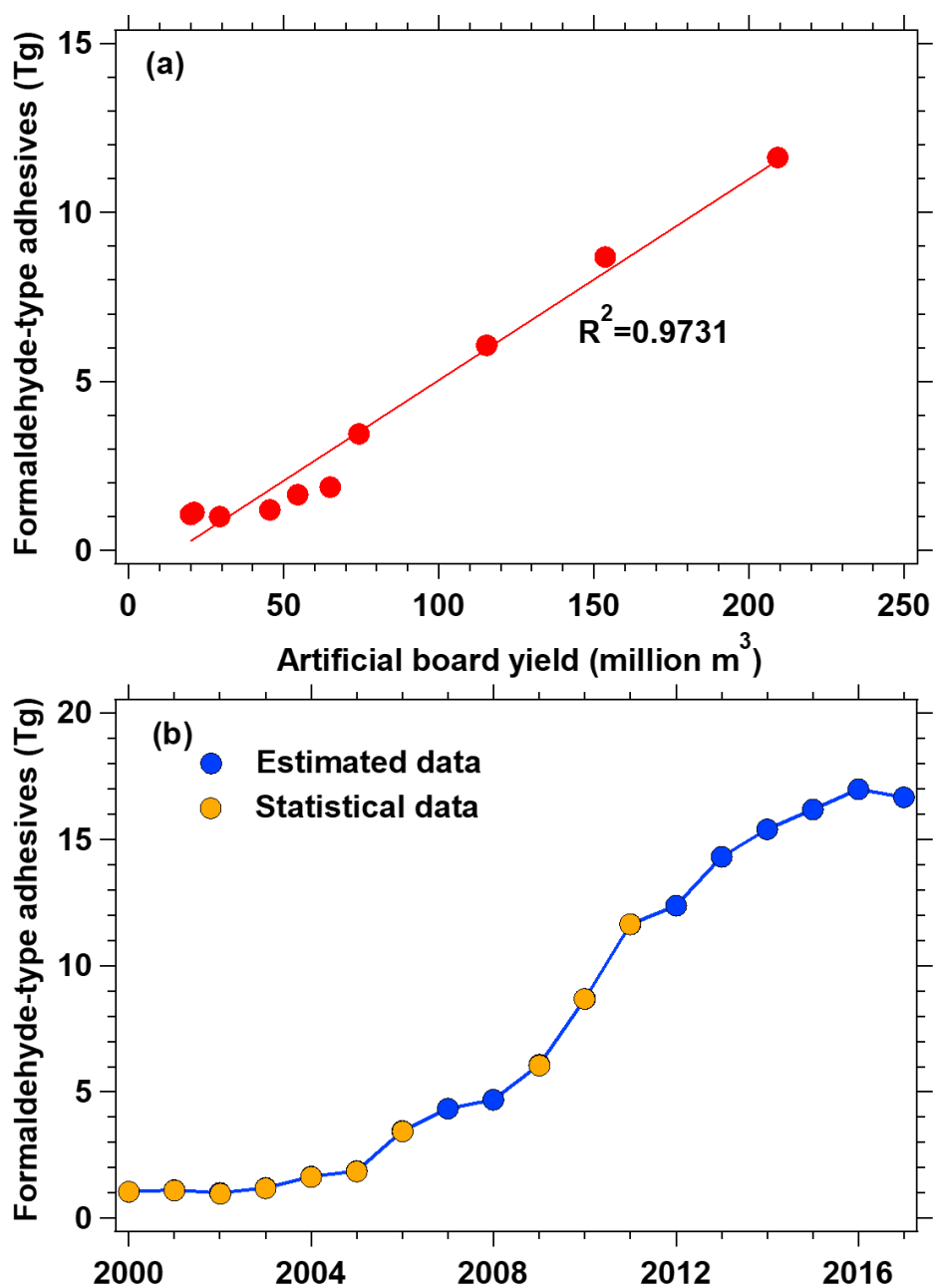
Reference	Base year and region	Emission sources		Emission factors	Units	Activity data sources or data (Tg)
Bo et al. (2008)	2005, China	Coating	Architecture surface coating	0.051	kg/capita	China Statistical Yearbooks, China Light Industry Yearbooks , China Market Yearbooks, China Industrial Economic Statistical Year
			Can coating	100	Mg/wire	
			Magnet wire coating	84	Mg/wire	
			Agriculture machines surface coating	236	Mg/plant	
			Surface coating of plastic parts for business machines	236	Mg/plant	
			Metal furniture surface coating	218	Mg/plant	
			Wood furniture	0.4	kg/piece	
			Machine tool equipment	0.4	kg/piece	
			Automobile & light duty truck surface coating	21.2	kg/vehicle	
			Large appliance surface coating	0.2	kg/production	
			Bicycle surface coating	0.3	kg/bike	
			Automobile recoating	0.021	kg/capita	
			Solvent degreasing	0.044	kg/capita	
		Others	Commercial/ Consumer solvent use	0.1	kg/capita	
Wei et al. (2011)	2010, China	Coating	Interior wall paint	180	g /kg paint	2.2
			Exterior wall paint	580	g /kg paint	1.7
			Auto-manufacturing paint	470	g /kg paint	0.2
			Auto-repair paint	720	g /kg paint	0.06
			Wood paint	640	g /kg paint	1.3

Reference	Base year and region	Emission sources		Emission factors	Units	Activity data sources or data (Tg)
		Adhesive	Other industrial paint	375	g /kg paint	2.5
			Shoemaking adhesive	670	g/kg adhesive	0.3
			Other adhesive	90	g/kg adhesive	6.4
		Ink	Printing	1210	g/kg ink	0.45
Yin et al. (2015)	2010, the PRD	Coating	Architecture surface coating	548.43	g/kg	Guangdong Statistical Yearbook 2011
			Car	4.8	kg/per vehicle	China Automotive Industry Yearbook 2011
			Truck	32	kg/per vehicle	
			Passenger car	7.8	kg/per vehicle	
			Motorcycle	1.5	kg/per vehicle	
			Bicycle	0.3	kg/per vehicle	
			Shipping coating	750	g/kg	China Machinery Industry Yearbook 2011
			Container coating	750	g/kg	Statistical Yearbook for each city in PRD
			Furniture Surface coating	0.54	kg/piece	
			Toy manufacturing	730	kg/t	Guangdong Statistical Yearbook
		Adhesive	Shoemaking	0.06	kg/pair	Statistical Yearbook for each city in PRD
			Artificial board	0.5	g/kg	
		Ink	Printing	320	g/kg	Guangdong Statistical Yearbook
			Printed circuit board	0.093	kg/m <sup>2</sup>	Statistical Yearbook for each city in PRD
		Others	Personal domestic product	0.5 for urban, 0.1 for rural	kg/capita	Guangdong Statistical Yearbook 2011

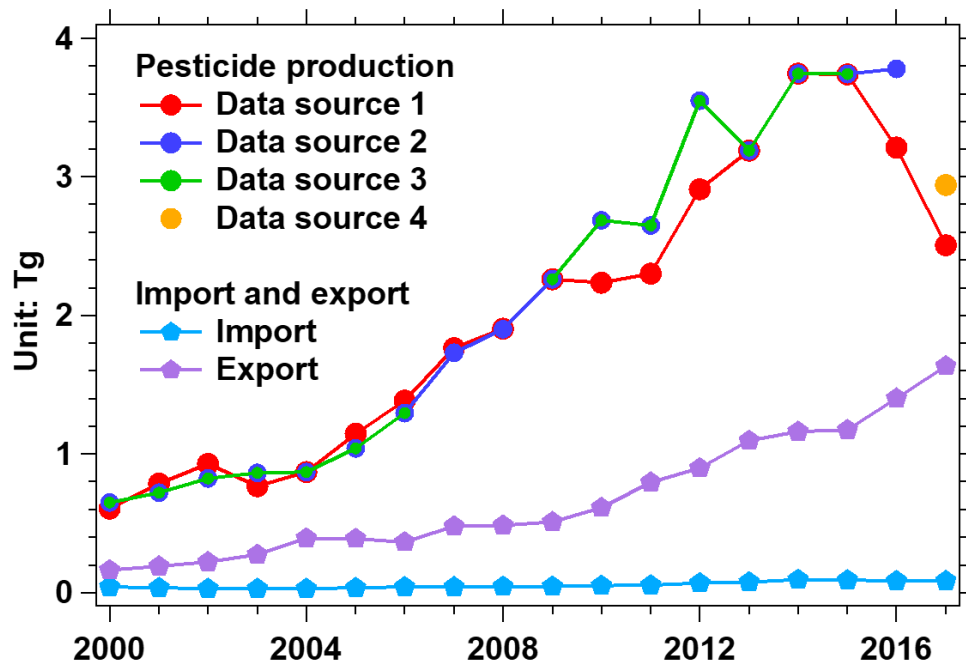
Reference	Base year and region	Emission sources		Emission factors	Units	Activity data sources or data (Tg)
Sun et al. (2018)	2009-2013, China	Coating	Interior wall paint	80	g/kg paint	China Statistical Yearbook, China Market Yearbooks, China Light Industry Yearbook, China Building Materials Industry Yearbook, China Industrial Economy Statistical Yearbook
			Exterior wall water paint	120 for waterborne, 450 for solvent-based	g/kg paint	
			Car	21.2	kg/car	
			Motorcycle	1.8	kg/motorcycle	
			Bicycle	0.3	kg/bicycle	
			Home appliance coating	0.2	kg/piece	
		Ink	Conventional printing	750	g/kg ink	
			New printing	100	g/kg ink	
		Pesticide	Insecticides	576	g/kg pesticide	
			Herbicides	276	g/kg pesticide	
			Bactericides	568	g/kg pesticide	
		Others	Decontamination and skimming	0.044	kg/capita	
			Consumer/commercial solvents	0.1	kg/capita	
Li et al. (2019) <sup>a</sup>	1990-2017, China	Coating	architecture interior wall coating	180 for waterborne, 620 for solvent-based	g/kg	China Paint and Coatings Industry Annual
			architecture other paint	300 for waterborne, 620 for solvent-based	g/kg	
			new car varnish paint	50 for waterborne, 730 for solvent-based	g/kg	
			vehicle refurnish paint	150 for waterborne, 750 for solvent-based	g/kg	
			decorations wood	225 for waterborne, 660 for	g/kg	

Reference	Base year and region	Emission sources		Emission factors	Units	Activity data sources or data (Tg)
				solvent-based		
			wood furniture	225 for waterborne, 660 for solvent-based	g/kg	
			other industry paint	440	g/kg	
		Adhesive	glue use	66	g/kg	China Council for the Promotion of International Trade (CCPIT)
		Ink	printing ink	540	g/kg	China Statistical Yearbook
		Pesticide	pesticide use	425.36	g/kg	
		Others	domestic solvent	0.5 for urban, 0.1 for rural	kg/capita	

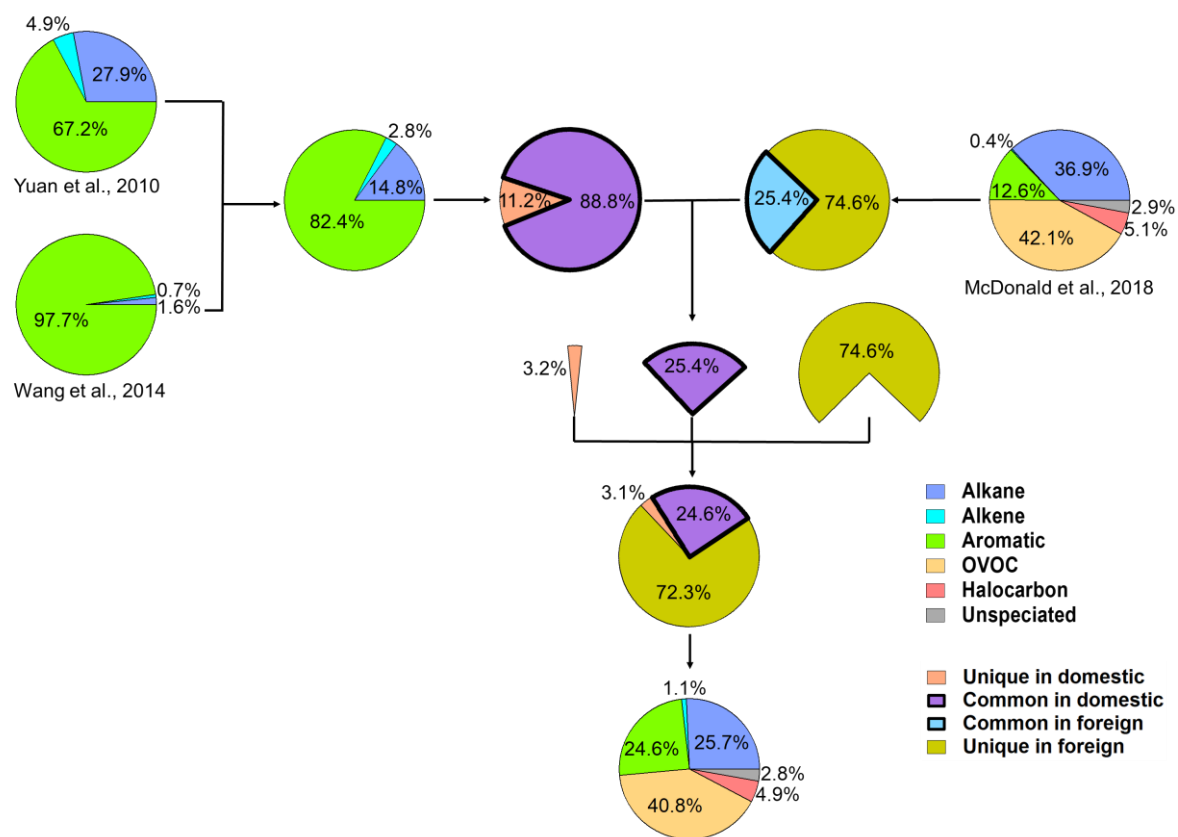
a. Emission factors in Li et al. (2019) are unabated emission factor without NMVOCs control.



**Figure S1.** (a) The linear relationship between formaldehyde-type adhesive consumption and the artificial board yield for estimating consumption of formaldehyde-type adhesive, and (b) consumption of formaldehyde-type adhesive during 2000-2017.

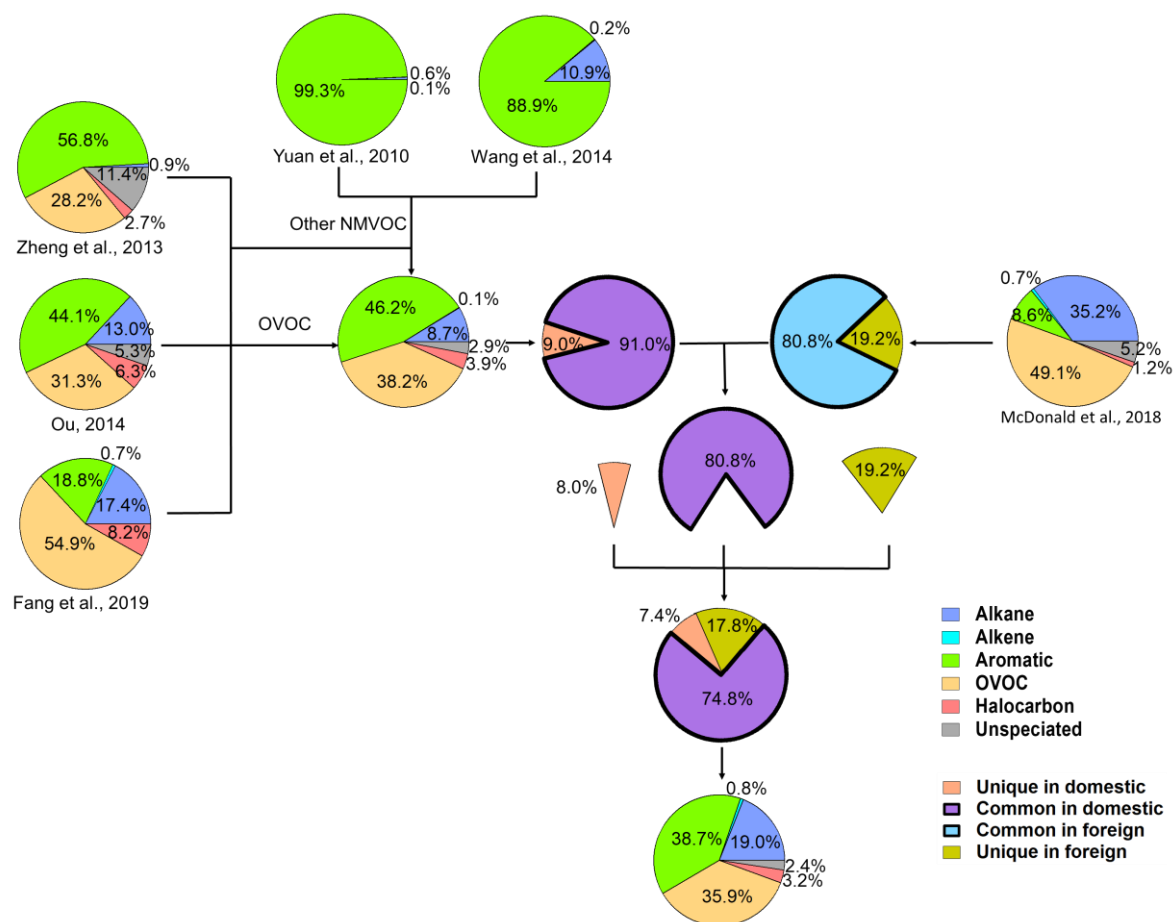


**Figure S2.** Pesticide production, import and export data during 2000-2017 in China. Data source 1: China Statistical Yearbook, missing import and export data; Data source 2: China Crop Protection Industry Yearbook; Data source 3: China Chemical Industry Yearbook; Data source 4: Duan (2018).

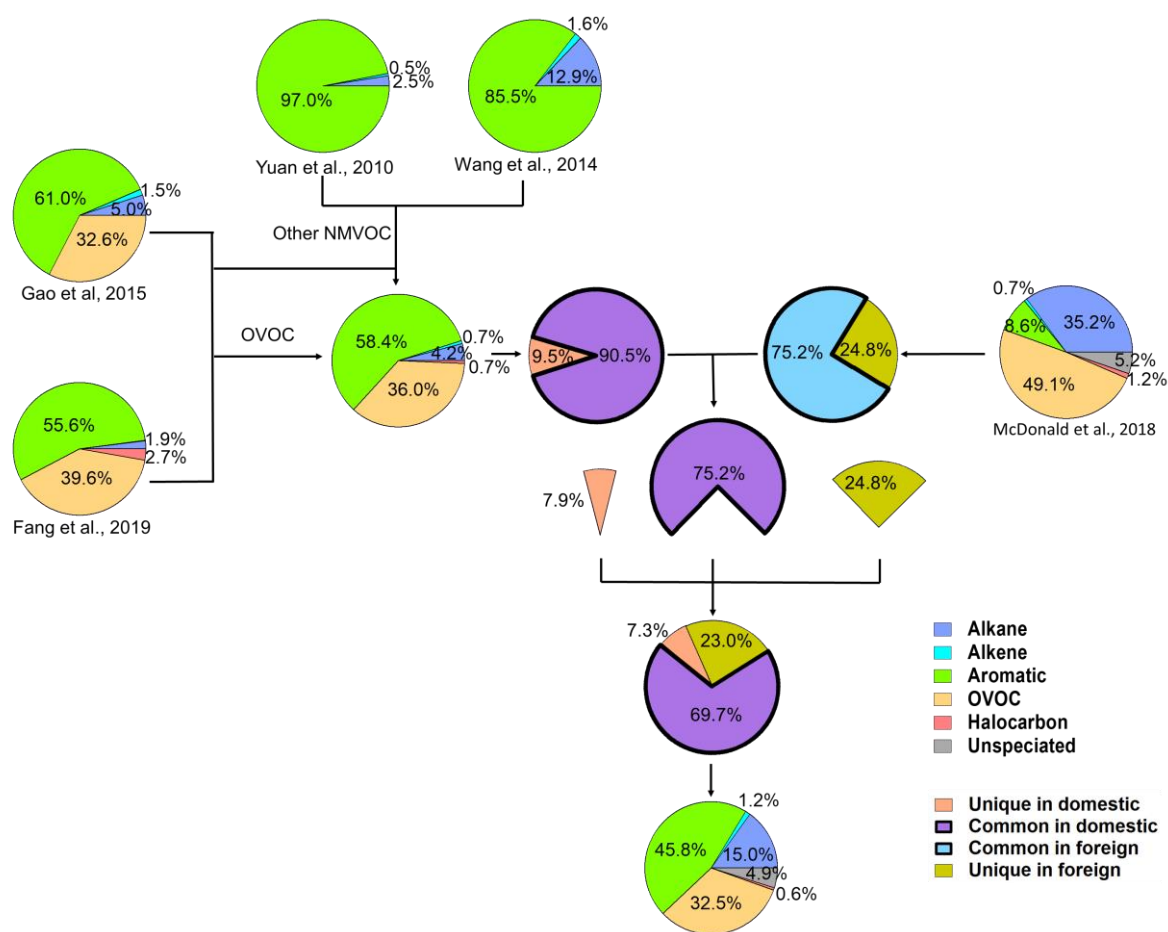


**Figure S3.** The procedure of obtaining merged source profiles for architectural coating.

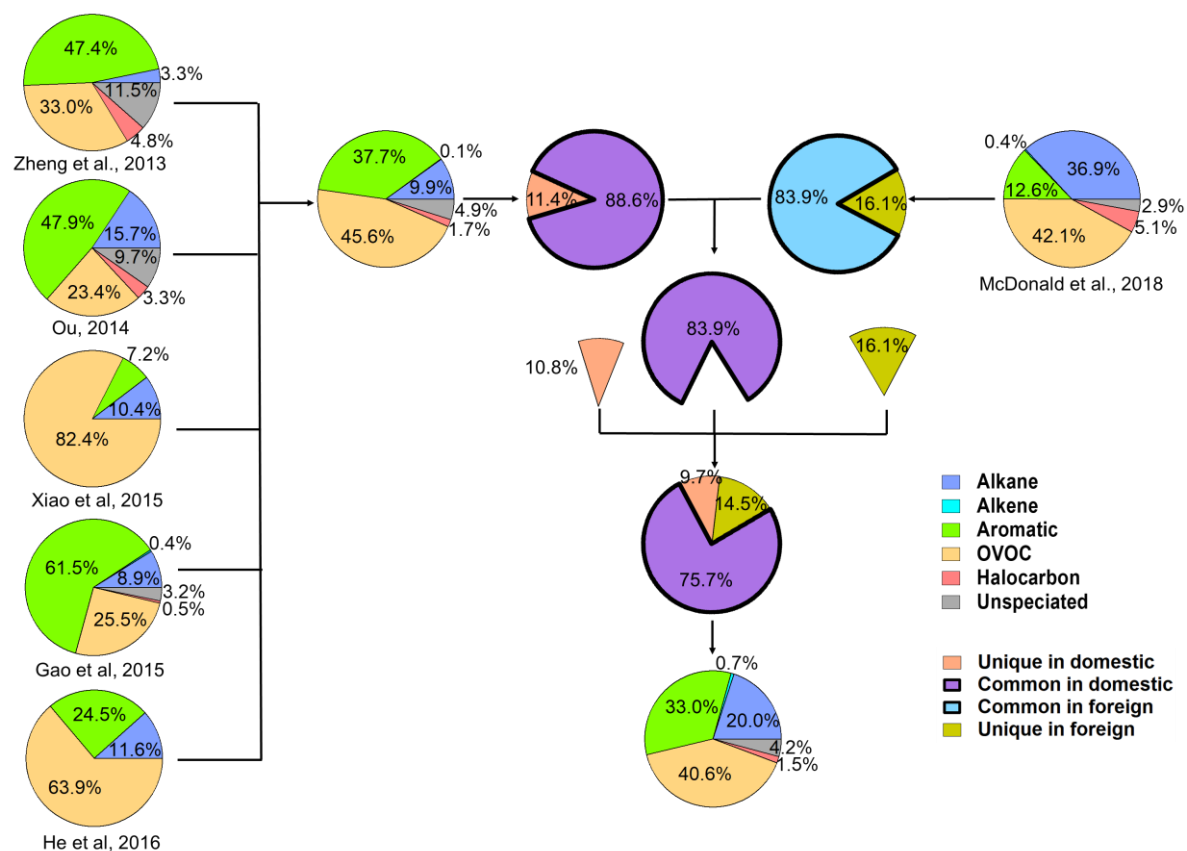




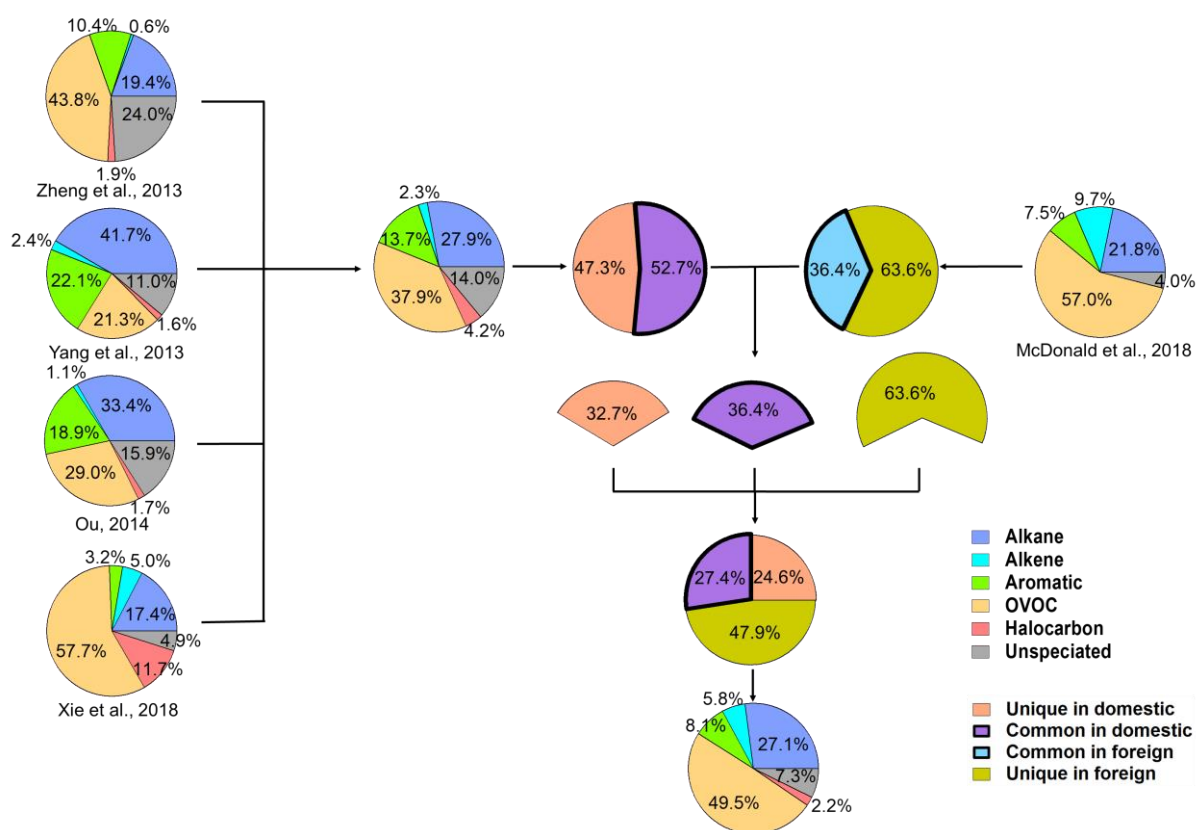
**Figure S4.** The procedure of obtaining merged source profiles for furniture coating.



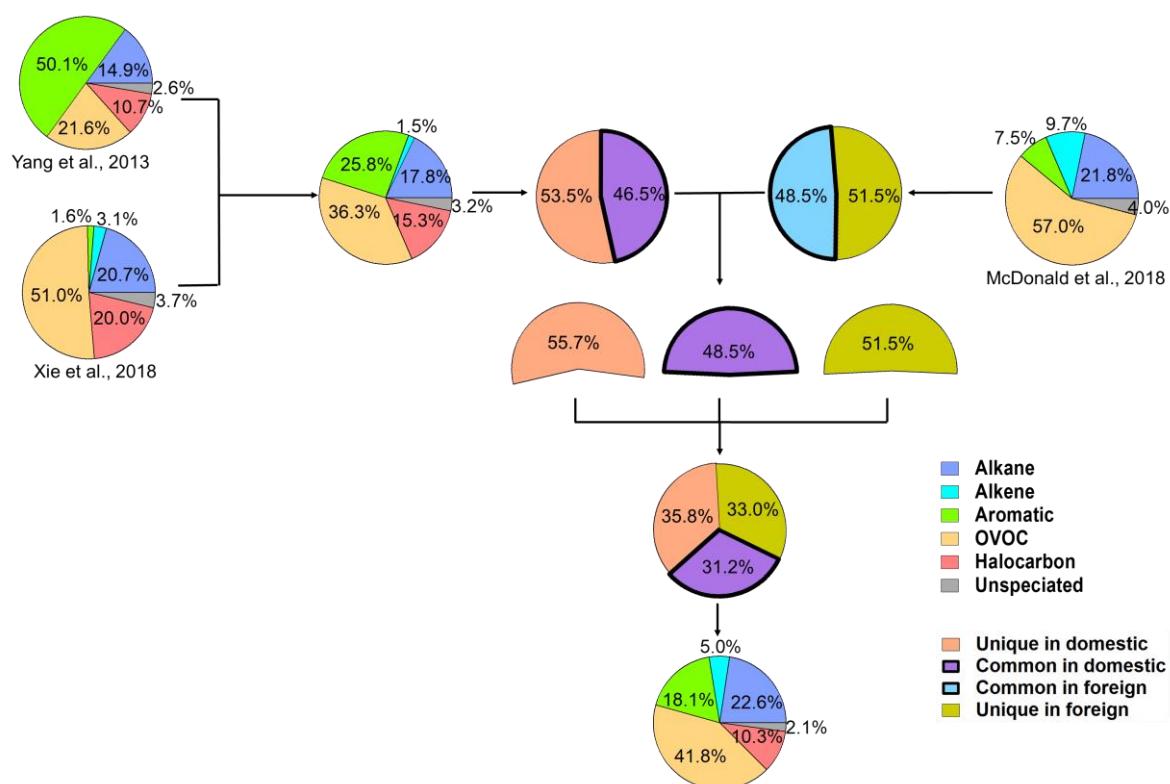
**Figure S5.** The procedure of obtaining merged source profiles for automobile coating.



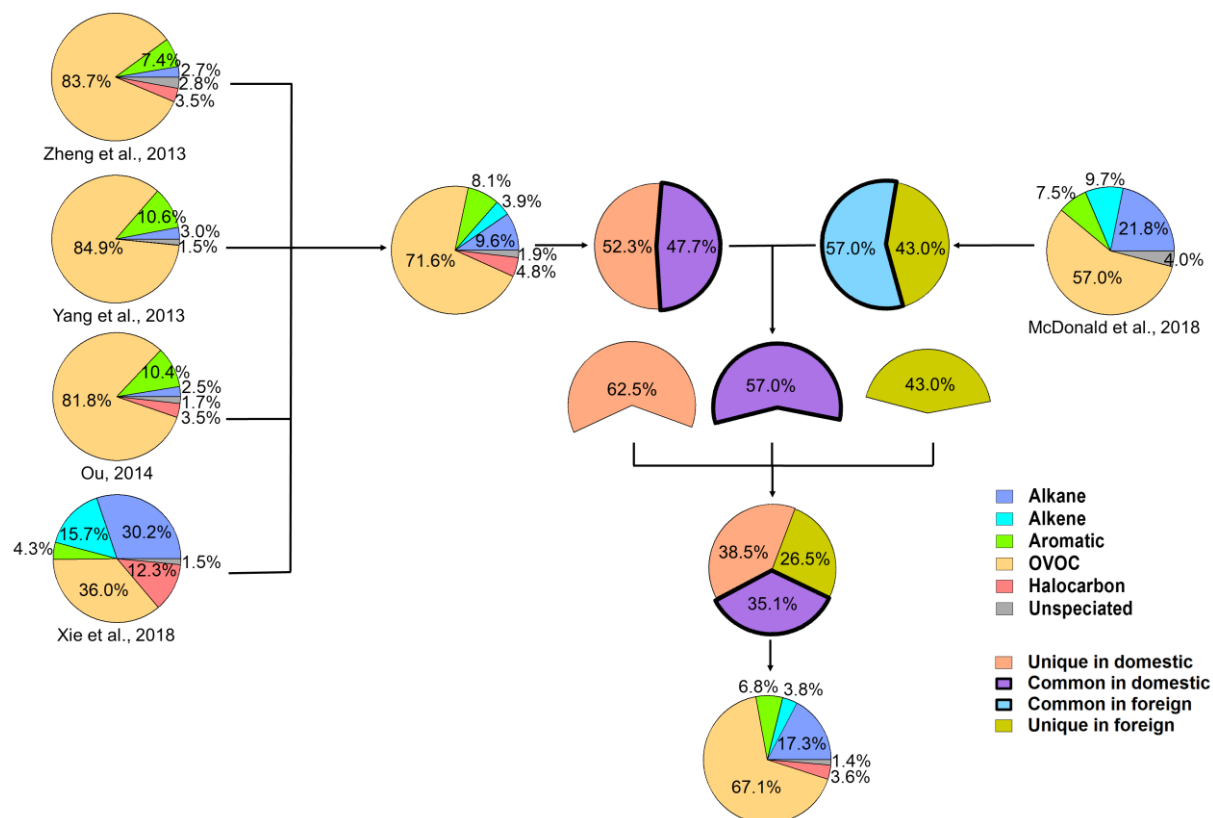
**Figure S6.** The procedure of obtaining merged source profiles for other industrial coating.



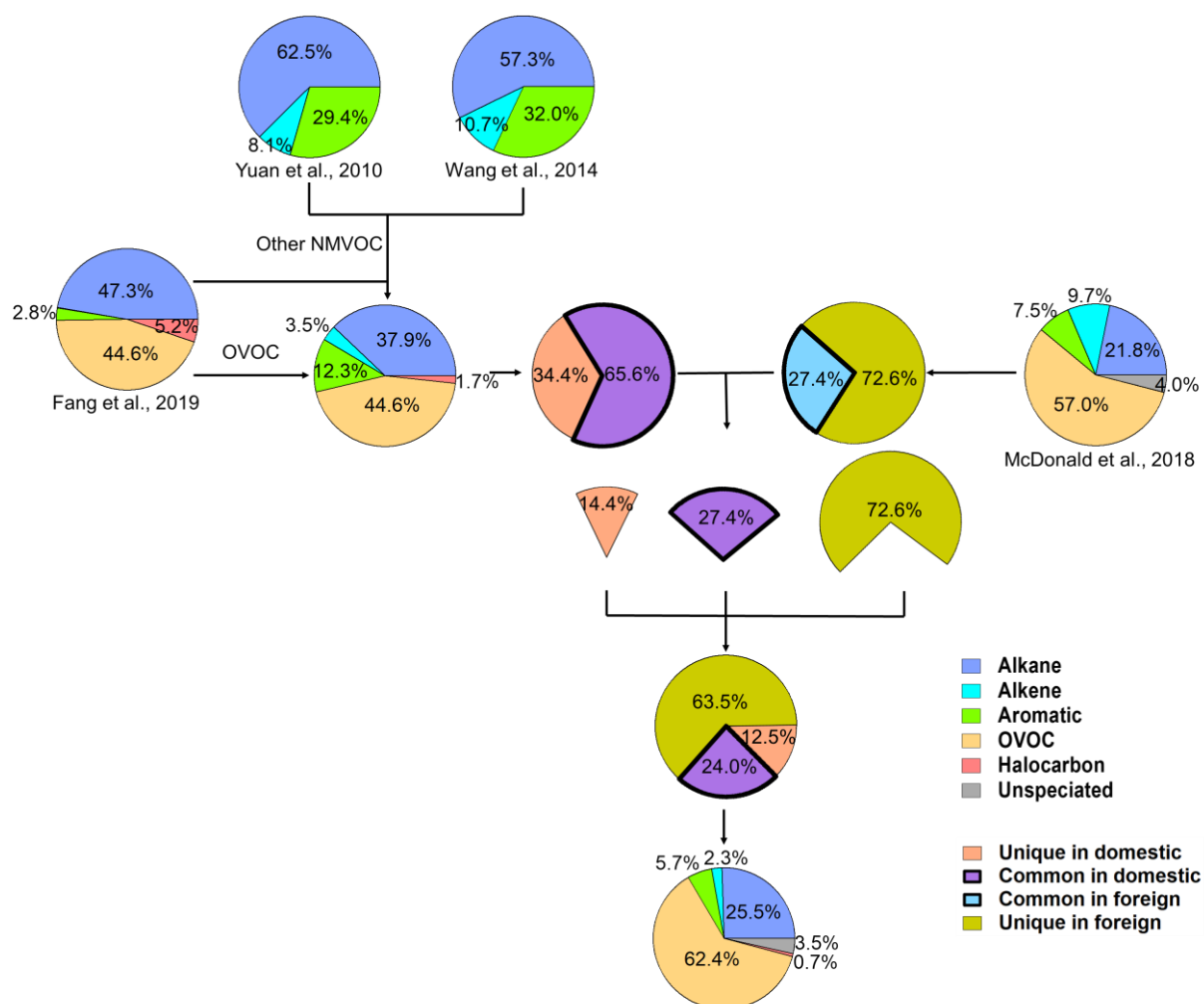
**Figure S7.** The procedure of obtaining merged source profiles for offset printing ink.



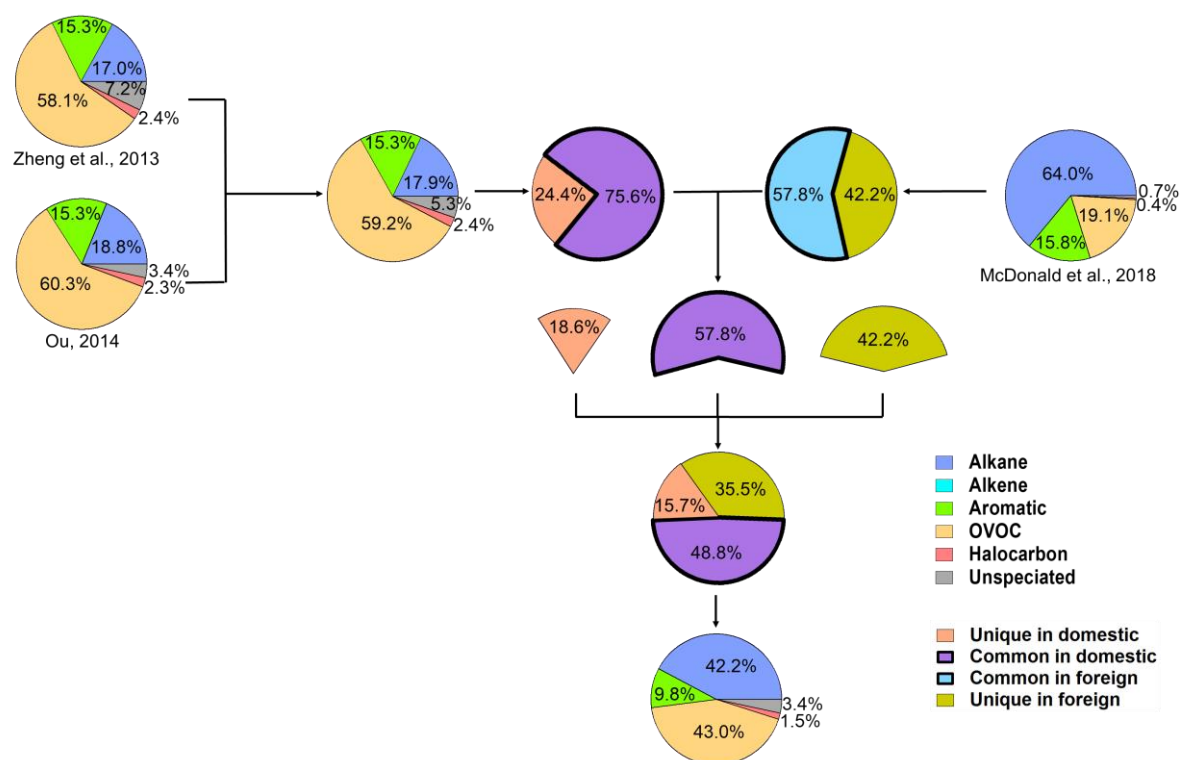
**Figure S8.** The procedure of obtaining merged source profiles for letterpress printing ink.



**Figure S9.** The procedure of obtaining merged source profiles for gravure printing ink.

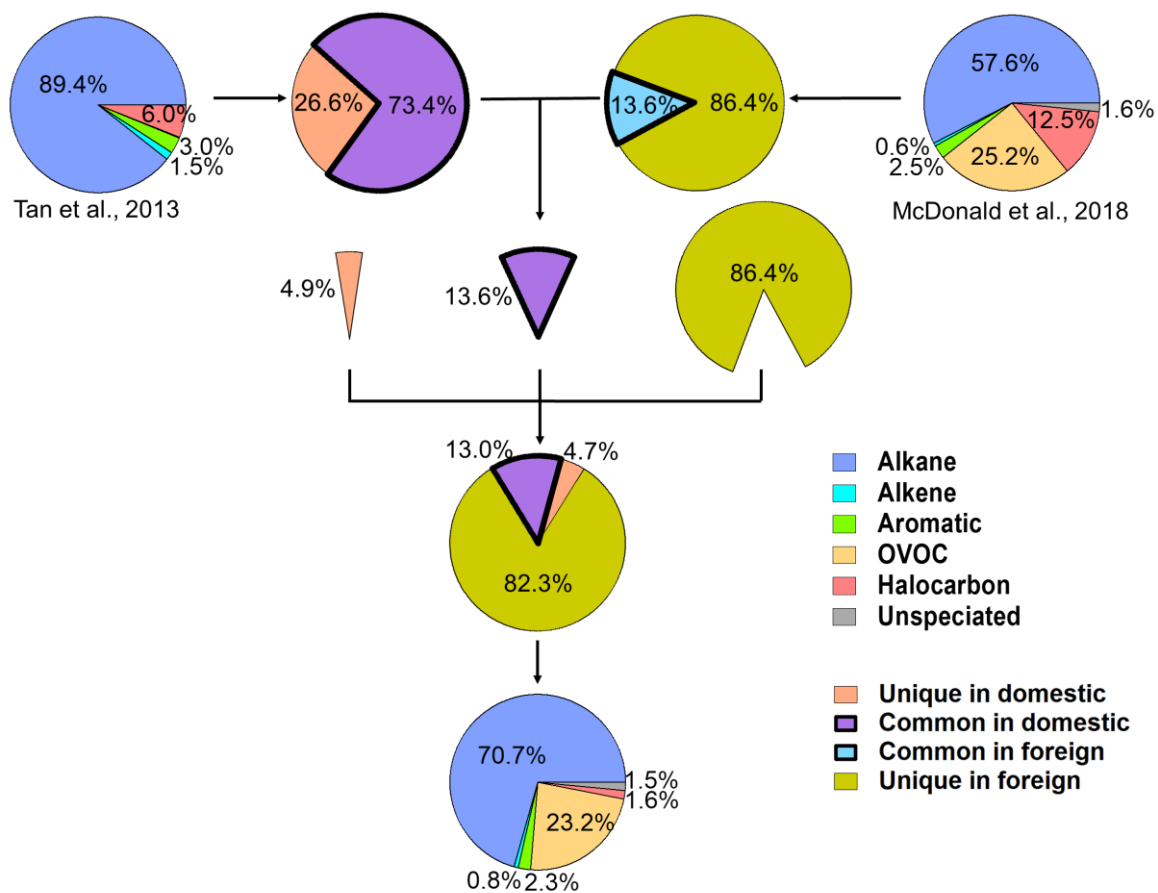


**Figure S10.** The procedure of obtaining merged source profiles for other printing ink.



**Figure S11.** The procedure of obtaining merged source profiles for shoemaking adhesive.





**Figure S12.** The procedure of obtaining merged source profiles for herbicide.

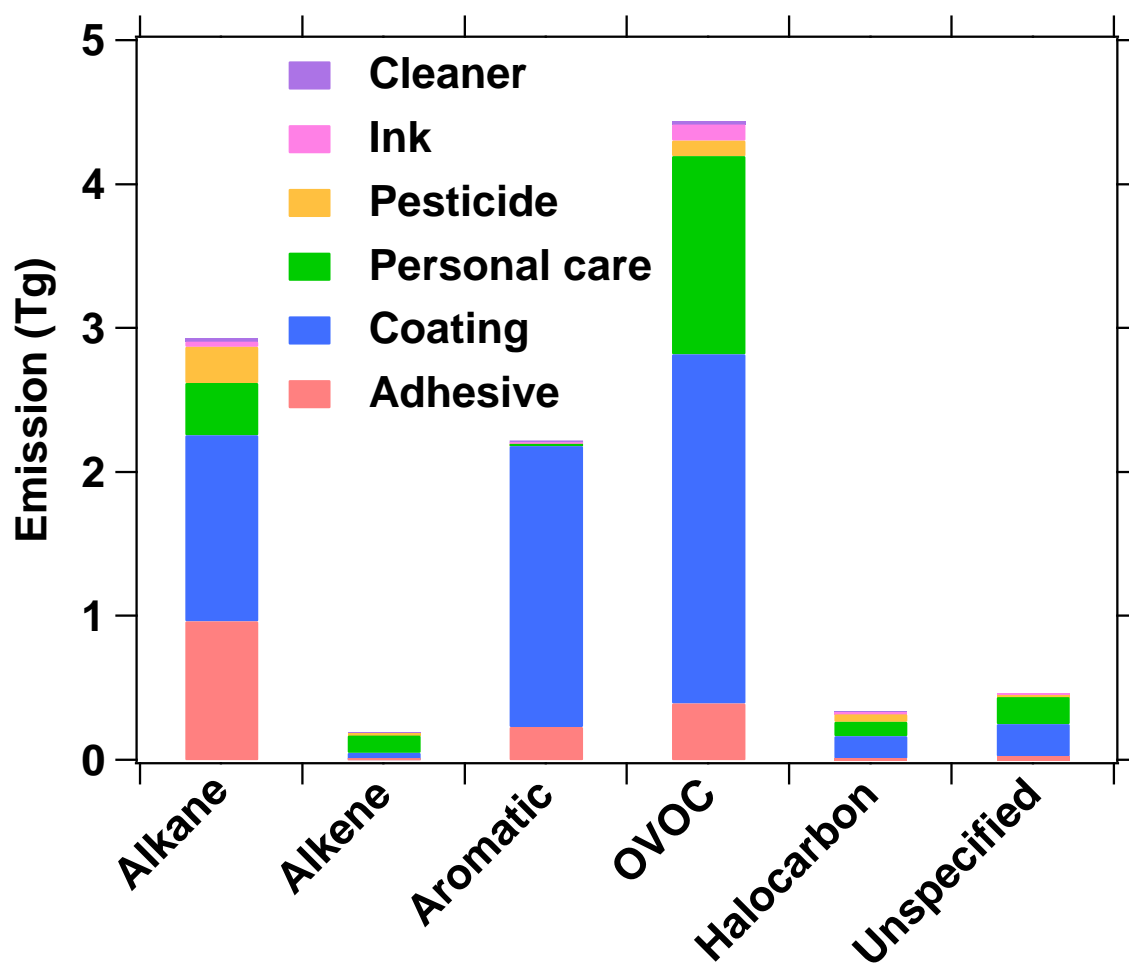


Figure S13. NMVOCs group emissions from various solvent categories in 2017.

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