Supplement of Atmos. Chem. Phys., 21, 13655–13666, 2021
https://doi.org/10.5194/acp-21-13655-2021-supplement

Supplement of

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

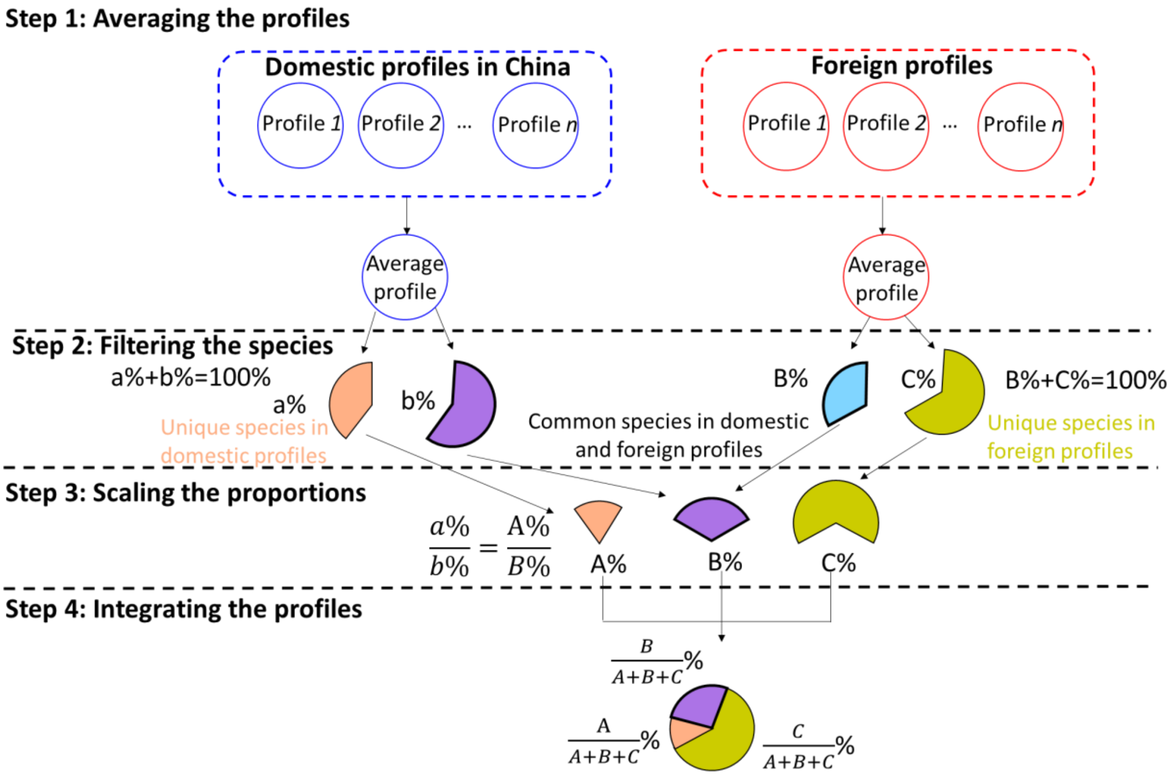
Ziwei Mo et al.

Correspondence to: Bin Yuan (byuan@jnu.edu.cn) and Min Shao (mshao@pku.edu.cn)

Contents

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. This compilation of the profiles can make use of the local measurements in China as well as including more comprehensive species, such as S/IVOCs being listed in the foreign profiles. The procedure involves four steps as shown in the following flow chart.



Step 1: A new domestic or foreign profile is formed by averaging weight percentages of NMVOCs groups from multiple source profiles. If some source profiles have OVOC, the treatment of OVOC followed the methods in Wu and Xie (2017) and Li et al. (2014) by averaging the NMHCs and OVOCs proportions, respectively.

Step 2: Common species in the domestic and foreign profiles are identified. Common species may account for different proportions in the domestic and foreign profiles. For example, common species account for b% in the average domestic profile, while B% in the average foreign profile. The remaining unique species account for a% in the domestic profile and C% in the foreign profile. Here a%+b%=100% and B%+C%=100%.

Step 3: We calculate proportion (b%) of common species in the domestic profile, then scale to proportions (B%) of common species in the foreign profile. At the same time, we scale the proportion of unique species in the domestic profile to be A% (=a÷b×B%). Because the foreign profile generally has more comprehensive species and the common species account for a smaller proportion. In order to include more species, we use the proportion of common species in the foreign profile as a reference for scaling.

Step 4: We integrate proportions of common species (B%), unique species in the domestic profile (A%) and unique species in the foreign profile (C%) into a new and complete source profile. Finally, the proportions of unique species in the domestic profile, common species in both the domestic and foreign profiles, and unique species in the foreign profiles are A/(A+B+C)%, B/(A+B+C)%, and C/(A+B+C)%, respectively.

Figure S3-S12 show the procedure and data source 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. Here, we take the architectural coating as an example to elaborate the detailed procedure for the chemical speciation following the four-step procedure (Figure S3).

Firstly, the domestic profiles of Yuan et al. (2010) and Wang et al. (2014) are averaged to form a new domestic profile, while the foreign profile of McDonald et al. (2018) is used.

Secondly, the common species in the domestic profile and foreign profiles are identified, accounting for 88.8% (b%) and 25.4% (B%), respectively. The unique species account for 11.2% (a%) in domestic profile while 74.6% (C%) in foreign profile.

Thirdly, the proportion of common species in domestic profile (88.8%) is scaled to proportion in foreign profile (25.4%; B%). The proportion of unique species in domestic profile is scaled to be 3.2% (= 11.2%÷88.8×25.4%; A%).

Finally, we normalized the proportions of common species, and unique species in the domestic and foreign profiles to generate the integrated profile.

.

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 70 76	71
	Water-based							12	12 15	13
Furniture coating	Solvent-based	80	65	75 80	66 50 75		60			69
	Water-based	15	10	30	14		5			15
	UV		10		14					12
Automotive coating	Solvent-based	80	45 80 55	45 80 55	50 45 80 55	45 80 55				61
	Water-based	15			5 15 15 20					14
	UV		10		14					12
Powder coating		0	0 0 5	2						1
Other coating	Solvent-based	80	70	65 60 80	70 40 70	65				67
	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 [a]	HJ 2542-2016 [b]	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 (%) [a]							
	Polyvinyl acetate	Polyvinyl alcohol	Rubber	Polyurethane	EAV	Acrylics	Other	Mean
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 (%) [a]					
	Polychloroprene rubber	SBS resin	Polyurethane	Acrylics	Other	Mean
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 (%) [a]								
	Organic silicon	MS	Polyurethane	Polysulfide	Acrylics	Epoxy resins	α-Cyanoacrylate	Thermoplastic	Other	Mean
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		40	HSECSM	
Industrial detergent		Water-based	5	GB 38508-2020 [a]	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 [a]		8		
	Body wash [a]		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	Green Seal	

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

Table S6. Five-tier evaluation system for uncertainty in activity data (Wei et al., 2011a).

Tier	Data source	Uncertainty
I	Directly from official statistics	± 30%
II	Estimated from other statistical information or reports; The data is strongly related; The statistical information or reports is reliable.	± 80%
III	Estimated from other statistical information or reports; The data is strongly related; The statistical information or reports are less reliable.	± 100%
IV	Estimated from other statistical information or reports; The data is less related; The statistical information or reports is reliable.	± 150%
V	The data is less related; The statistical information or reports is less reliable.	± 300%

Table S7. 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 [a]	Architectural coating	Solvent-based	71 ± 3	0.99	0.01	1 ± 0	1	0.70 ± 0.20
		Water-based	13 ± 1	0.76	0.24	4 ± 0	1	0.70 ± 0.20
	Furniture coating*	Solvent-based	69 ± 10	0.99	0.01	1 ± 0	1	0.70 ± 0.20
		Water-based	15 ± 8	0.76	0.24	5 ± 3	1	0.70 ± 0.20
		UV	12 ± 2	0.76	0.24	4 ± 1	1	0.70 ± 0.20
	Automotive coating*	Solvent-based	61 ± 15	0.99	0.01	1 ± 0	1	0.70 ± 0.20
		Water-based	14 ± 5	0.76	0.24	4 ± 1	1	0.70 ± 0.20
		UV	12 ± 2	0.76	0.24	4 ± 1	1	0.70 ± 0.20
	Powder coating*		1 ± 2	0.76	0.24	0 ± 0	1	0.70 ± 0.20
	Other*	Solvent-based	67 ± 11	0.99	0.01	1 ± 0	1	0.70 ± 0.20
		Water-based	18 ± 8	0.76	0.24	6 ± 3	1	0.70 ± 0.20
		UV	12 ± 2	0.76	0.24	4 ± 1	1	0.70 ± 0.20
Ink [b]	Offset ink	Sheet-fed offset Ink	4 ± 1	0.86	0.14	1 ± 0	1	0.70 ± 0.20
		Cold set web-fed-offset ink	3 ± 1	0.86	0.14	0 ± 0	1	0.70 ± 0.20
		Heat set web-fed-offset ink	23 ± 11	0.86	0.14	4 ± 2	1	0.70 ± 0.20
	Letterpress ink	Solvent-based	60 ± 0	0.86	0.14	10 ± 0	1	0.70 ± 0.20
		Water-based	13 ± 3	0.86	0.14	2 ± 0	1	0.70 ± 0.20
	Gravure ink	Solvent-based	63 ± 6	0.86	0.14	10 ± 1	1	0.70 ± 0.20
		Water-based	23 ± 8	0.86	0.14	4 ± 1	1	0.70 ± 0.20
	UV ink		1 ± 1	0.86	0.14	0 ± 0	1	0.70 ± 0.20
	Screen ink		46 ± 2	0.86	0.14	7 ± 0	1	0.70 ± 0.20
	Other		60 ± 0	0.86	0.14	10 ± 0	1	0.70 ± 0.20
Adhesive [c]	Architecture	Water-based	9 ± 3	0.86	0.14	1 ± 1	1	0.70 ± 0.20
		Solvent-based	54 ± 6	0.89	0.11	7 ± 1	1	0.70 ± 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 ± 3	0.86	0.14	1 ± 0	1	0.70 ± 0.20
	Residential use	Water-based	5 ± 0	0.86	0.14	1 ± 0	1	0.70 ± 0.20
		Solvent-based	42 ± 14	0.89	0.11	5 ± 2	1	0.70 ± 0.20
		Bulk form	7 ± 5	0.86	0.14	1 ± 1	1	0.70 ± 0.20
	Woodworking*	Water-based	7 ± 2	0.86	0.14	1 ± 0	1	0.70 ± 0.20
		Solvent-based	48 ± 8	0.89	0.11	6 ± 1	1	0.70 ± 0.20
		Bulk form	7 ± 5	0.86	0.14	1 ± 1	1	0.70 ± 0.20
		Formaldehyde type	5 ± 4 [d]	0.86	0.14	1 ± 1	1	0.70 ± 0.20
	Paper converting*	water-based	5 ± 0	0.86	0.14	1 ± 0	1	0.70 ± 0.20
		Solvent-based	42 ± 14	0.89	0.11	5 ± 2	1	0.70 ± 0.20
		Bulk form	5 ± 0	0.86	0.14	1 ± 0	1	0.70 ± 0.20
	Shoemaking*	Water-based	8 ± 4	0.86	0.14	1 ± 1	1	0.70 ± 0.20
		Solvent-based	48 ± 8	0.89	0.11	6 ± 1	1	0.70 ± 0.20
		Bulk form	4 ± 1	0.86	0.14	1 ± 0	1	0.70 ± 0.20
	Fiber processing*	Water-based	5 ± 0	0.86	0.14	1 ± 0	1	0.70 ± 0.20
		Solvent-based	42 ± 14	0.89	0.11	5 ± 2	1	0.70 ± 0.20
		Bulk form	5 ± 0	0.86	0.14	1 ± 0	1	0.70 ± 0.20
	Transportation	Water-based	5 ± 0	0.86	0.14	1 ± 0	1	0.70 ± 0.20
		Solvent-based	42 ± 14	0.89	0.11	5 ± 2	1	0.70 ± 0.20
		Bulk form	8 ± 5	0.86	0.14	1 ± 1	1	0.70 ± 0.20
	Packaging and labelling*	Water-based	5 ± 0	0.86	0.14	1 ± 0	1	0.70 ± 0.20
		Solvent-based	50 ± 6	0.89	0.11	6 ± 1	1	0.70 ± 0.20
		Bulk form	6 ± 2	0.86	0.14	1 ± 0	1	0.70 ± 0.20
	Other	Water-based	5 ± 0	0.86	0.14	1 ± 0	1	0.70 ± 0.20
		Solvent-based	42 ± 14	0.89	0.11	5 ± 2	1	0.70 ± 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 ± 5	0.86	0.14	1 ± 1	1	0.70 ± 0.20
Pesticide	Insecticide		24 ± 2	0.5	0.5	24 ± 2	1	0.30 ± 0.25
	Herbicide		24 ± 2 [f]	0.5	0.5	24 ± 2	1	0.30 ± 0.25
	Bactericide		24 ± 2 [f]	0.5	0.5	24 ± 2	1	0.30 ± 0.25
	Other		24 ± 2 [f]	0.5	0.5	24 ± 2	1	0.30 ± 0.25
Cleaner	Laundry		16 ± 18	0.81	0.19	4 ± 4	0.007 ± 0.005	0
	Dishwashing		10 ± 0	0.92	0.08	1 ± 0	0.044 ± 0.006	0
	Surface cleaner		9 ± 11	0.78	0.22	3 ± 4	0.47 ± 0.38	0
	Industrial detergent [e*]	Water-based	5 ± 0	0.22	0.78	18 ± 0	0.25	0.25
		Solvent-based	90 ± 0	0.99	0.01	1 ± 0	1	0.70 ± 0.20
Personal care	Hair and body care		23 ± 23	0.91	0.09	2 ± 2	0.60 ± 0.40	0
	Perfume		70 ± 5	0.78	0.22	20 ± 1	1	0.40 ± 0.15
	Skin care		35 ± 0	0.93	0.07	3 ± 0	1	0.40 ± 0.15
	Other		18 ± 27	0.86	0.14	3 ± 4	0.80 ± 0.20	0.40 ± 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 2013and 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 Vzkoo (2019).

f. Data are referred to that of insecticide.

* indicates the industrial solvent use.

Table S8. Proxy variables for allocating national emissions to provincial level.

<table>
<tr><td colspan="2">Solvent use</td><td>Proxy variable</td></tr>
<tr><td colspan="2">Pesticide</td><td>Cultivated land area [a]</td></tr>
<tr><td colspan="2">Personal care</td><td>Disposable income of households [a]</td></tr>
<tr><td rowspan="2">Cleaner</td><td>Industrial detergent</td><td>Industrial sales value [b]</td></tr>
<tr><td>Other cleaner</td><td>Disposable income of households [a]</td></tr>
<tr><td rowspan="4">Coating</td><td>Architectural coating</td><td>Building area completed [a]</td></tr>
<tr><td>Automotive coatings</td><td>Sales value of automobile manufacturing [b]</td></tr>
<tr><td>Furniture coatings</td><td>Sales value of furniture manufacturing [b]</td></tr>
<tr><td>Other coatings</td><td>Industrial sales value [b]</td></tr>
<tr><td colspan="2">Ink</td><td>Sales value of printing and recording media reproduction industry [b]</td></tr>
<tr><td rowspan="8">Adhesive</td><td>adhesives for wood processing</td><td>Sales value of wood processing [b]</td></tr>
<tr><td>Adhesives for paper processing, label</td><td>Sales value of printing and recording media reproduction industry [b]</td></tr>
<tr><td>Adhesives for fiber processing</td><td>Sales value of fiber processing [b]</td></tr>
<tr><td>Adhesives for transportation</td><td>Sales value of automobile manufacturing [b]</td></tr>
<tr><td>Adhesives for building</td><td>Building area completed [a]</td></tr>
<tr><td>Adhesives for making shoes</td><td>Sales value of making shoes [b]</td></tr>
<tr><td>Adhesives for residential use</td><td>Disposable income of households [a]</td></tr>
<tr><td>Other adhesives</td><td>Industrial sales value [b]</td></tr>
</table>

a. Data from 2017 China Statistical Yearbook

b. Data from 2017 China Industry Statistical Yearbook

Table S9. List of VOCs and S/IVOCs and their MIR and SOA yield values used in this study.

No.	Species	MIR	SOA yield
	Alkanes		
1	Ethane	0.28	0
2	Propane	0.49	0
3	Isobutane	1.23	0
4	N-butane	1.15	0
5	Cyclopentane	2.39	0.012
6	Isopentane	1.45	0
7	N-pentane	1.31	0
8	methylcyclopentane	2.19	0.022
9	Cyclohexane	1.25	0.022
10	2,2-dimethylbutane	1.17	0
11	2,3-dimethylbutane	0.97	0
12	2-methylpentane	1.5	0
13	3-methylpentane	1.8	0
14	N-hexane	1.24	0.0028
15	Methylcyclohexane	1.7	0.035
16	2,3-dimethylpentane	1.34	0.0083
17	2,4-dimethylpentane	1.55	0.0083
18	2-methylhexane	1.19	0
19	3-methylhexane	1.61	0
20	N-heptane	1.07	0.0066
21	Ethylcyclohexane	1.47	0.051
22	2,2,4-Trimethylpentane	1.26	0.003
23	2,3,4-Trimethylpentane	1.03	0.003
24	2-methylheptane	1.07	0.003
25	3-methylheptane	1.24	0.003
26	N-octane	0.9	0.013
27	1,2-Dimethylcyclohexane	1.41	0.051
28	1,3-Dimethylcyclohexane	1.52	0.051
29	4-Methylheptane	1.25	0.003
30	N-nonane	0.78	0.021
31	1,1,3-Trimethylcyclohexane	1.19	0.068
32	1,2,4-Trimethylcyclohexane	1.36	0.068
33	1-Ethyl-3-methylcyclohexane	1.36	0.068
34	1-Ethyl-4-methylcyclohexane	1.44	0.068
35	2,5-Dimethylheptane	1.35	0.0083
36	3-Ethylheptane	1.1	0.0083
37	3-Methyloctane	0.99	0.0083
38	4-Methyloctane	0.95	0.0083
39	N-decane	0.68	0.033
40	2,6-Dimethyloctane	1.08	0.02

Table S9 (continued).

No.	Species	MIR	SOA yield
41	2-Methylnonane	0.73	0.02
42	Endo-tricyclo[5.2.1.0(2.6)]decane	1.09	0.068
43	N-undecane	0.61	0.05
44	N-dodecane	0.55	0.069
45	2,2,4,6,6-Pentamethylheptane	0.63	0.069
46	n-tetradecane	0.51	0.11
47	n-pentadecane	0.5	0.14
48	n-Hexadecane	0.45	0.19
49	n-Heptadecane	0.42	0.26
50	N-tridecane	0.53	0.09
51	branched C9 alkanes	1.14	0.0083
52	branched C10 alkanes	0.94	0.02
53	branched C11 alkanes	0.73	0.04
54	branched C8 alkanes	1.45	0.003
55	branched C6 alkanes	1.31	0
56	branched C7 alkanes	1.48	0
57	branched C5 alkanes	1.45	0
58	branched C12 alkanes	0.63	0.069
59	branched C13 alkanes	0.6	0.11
60	branched C16 alkanes	0.47	0.3
61	branched C15 alkanes	0.5	0.22
62	branched C17 alkanes	0.44	0.41
63	branched C14 alkanes	0.55	0.15
64	2,2,4,4,6,8,8-heptamethylnonane	0.47	0.3
65	C8 cycloalkanes	1.47	0.051
66	C9 cycloalkanes	1.36	0.068
67	C11 cycloalkanes	0.9	0.11
68	C10 cycloalkanes	1.07	0.087
69	C7 cycloalkanes	1.7	0.035
70	C6 cycloalkanes	1.25	0.022
71	C10 bicycloalkanes	1.09	0.087
72	C11 bicycloalkanes	0.91	0.11
73	C12 cycloalkanes	0.8	0.15
74	C15 cycloalkanes	0.61	0.31
75	C16 cycloalkanes	0.55	0.36
76	C14 cycloalkanes	0.65	0.25
77	C13 cycloalkanes	0.7	0.19
78	C17 cycloalkanes	0.52	0.43
	Alkenes		
79	Ethylene	9	0
80	Propylene	11.66	0

Table S9 (continued).

No.	Species	MIR	SOA yield
81	1,3-butadiene	12.61	0
82	1-butene	9.73	0
83	Isobutene	6.29	0
84	cis-2-Butene	14.24	0
85	trans-2-Butene	15.16	0
86	Isoprene	10.61	0.026
87	1-Pentene	7.21	0.026
88	cis-2-Pentene	10.38	0.026
89	trans-2-Pentene	10.56	0.026
90	2-Methyl-1-butene	6.4	0
91	1-Hexene	5.49	0.077
92	2-Methyl-1-pentene	5.26	0.077
93	3,5-Dimethyl-3-heptene	4.54	0.16
94	Tetrahydrodicyclopentadiene	3.93	0.13
95	α-Pinene	4.51	0.13
96	Limonene	4.55	0.13
97	C11 internal alkenes	3.6	0.25
98	C9 cyclic olefins or di-olefins	4.62	0.094
99	C11 terminal alkenes	1.87	0.25
100	C7 terminal alkenes	4.43	0.077
101	C9 internal alkenes	4.54	0.16
102	C10 internal alkenes	3.87	0.19
103	terpinolene	6.36	0.13
104	dodecene	1.64	0.32
	Alkyne		
105	Acetylene	0.95	0
	Aromatics		
106	Benzene	0.72	0
107	Toluene	4	0.09
108	m/p-Xylene	7.795	0.049
109	Ethylbenzene	3.04	0.049
110	O-Xylene	7.64	0.049
111	Styrene	1.73	0.049
112	1,2,3-Trimethylbenzene	11.97	0.073
113	1,2,4-Trimethylbenzene	8.87	0.073
114	1,3,5-Trimethylbenzene	11.76	0.073
115	Isopropylbenzene	2.52	0.073
116	1-Methyl-3-ethylbenzene	7.39	0.073
117	N-propylbenzene	2.03	0.073
118	1-Methyl-2-ethylbenzene	5.59	0.073
119	1-Methyl-4-ethylbenzene	4.44	0.073
120	Allylbenzene	1.53	0.073

121	Cyclopropylbenzene	2.03	0.073
122	indene	1.55	0.16
123	1,3-diethylbenzene	7.1	0.1
124	1,4-diethylbenzene	4.43	0.1
125	1,2-diethylbenzene	5.49	0.1
126	Naphthalene	3.34	0.2
127	2-Isopropyltoluene	5.49	0.1
128	4-Isopropyltoluene	4.44	0.1
129	1,2,3,4-tetramethylbenzene	9.26	0.1
130	1,2,3,5-tetramethylbenzene	9.26	0.1
131	1,2,4,5-tetramethylbenzene	9.26	0.1
132	1-Ethyl-2,4-dimethylbenzene	7.55	0.1
133	1-Methyl-3-Propylbenzene	7.1	0.1
134	1-Methyl-4-Propylbenzene	4.43	0.1
135	2-Ethyl-1,3-dimethylbenzene	10.15	0.1
136	2-Ethyl-1,4-dimethylbenzene	7.55	0.1
137	4-Ethyl-1,2-dimethylbenzene	7.55	0.1
138	1-Ethyl-2,3-dimethylbenzene	10.15	0.1
139	sec-Butylbenzene	2.36	0.1
140	p-sec-Butyltoluene	4.92	0.15
141	C10 disubstituted benzenes	5.68	0.1
142	C10 trisubstituted benzenes	9.26	0.1
143	C9 trisubstituted benzenes	10.87	0.073
144	C10 tetrasubstituted benzenes	9.26	0.1
145	Methyl indanes	2.97	0.21
146	C10 monosubstituted benzenes	2.36	0.1
147	C9 disubstituted benzenes	5.81	0.073
148	N-butylbenzene	2.36	0.1
149	C11 trisubstituted benzenes	8.13	0.15
150	C12 trisubstituted benzenes	7.3	0.23
151	C11 tetrasubstituted benzenes	8.13	0.15
152	C14 naphthalenes	3.3	0.49
153	C12 naphthalenes	3.89	0.36
154	C11 tetralins or indanes	2.69	0.28
155	C15 naphthalenes	3.06	0.52
156	C11 disubstituted benzenes	4.92	0.15
157	C13 naphthalenes	3.57	0.43
158	C13 trisubstituted benzenes	6.57	0.34
159	C14 trisubstituted benzenes	6	0.46
160	C11 monosubstituted benzenes	2.12	0.15
161	C11 pentasubstituted benzenes	8.13	0.15
162	C16 naphthalenes	2.86	0.54
163	2-Methylnaphthalene	3.06	0.28
	Oxygenated VOCs		

164	Formaldehyde	9.46	0
165	Ethanol	1.53	0
166	Acraldehyde	7.45	0
167	Acetone	0.36	0
168	Isopropyl alcohol	0.61	0
169	Methyl acetate	0.072	0
170	Dimethoxymethane	0.94	0
171	Dimethyl carbonate	0.059	0
172	Vinyl acetate	3.2	0
173	2-Butanone	1.48	0
174	Ethyl acetate	0.63	0
175	Tetrahydrofuran	4.31	0
176	n-butyl alcohol	2.88	0
177	2-Ethoxyethanol	3.71	0
178	propylene glycol methyl ether	2.44	0
179	tert-Butanol	0.41	0
180	2-Methoxy-2-propanol	3.01	0
181	Methyl tert-butyl ether	0.73	0.039
182	Methyl methacrylate	15.61	0.0085
183	Ethyl Acrylate	7.77	0.0085
184	Methyl isopropyl ether	3.74	0
185	Propyl acetate	0.78	0.0085
186	Methyl isobutyl ketone	3.88	0.013
187	2-hexanone	3.14	0.013
188	N-butyl acetate	0.83	0.014
189	Cyclohexanone	1.35	0.0019
190	sec-Butyl acetate	1.32	0.014
191	propylene glycol methyl ether acetate	1.7	0.029
192	Isobutyl acetate	0.62	0.014
193	2-Ethoxyethyl acetate	1.84	0.11
194	2-Butoxyethanol	2.9	0.052
195	Butyl Acrylate	5.02	0.0215
196	2-Pentyl Acetate	1.33	0.0215
197	2-Ethyl-1-hexanol	2	0.16
198	4-Methylbenzaldehyde	3.16	0.002
199	2,6-Dimethyl-4-heptanone	2.68	0.029
200	2-Phenyl-2-propanol	4.53	0.036
201	Dimethyl ether	0.81	0
202	methanol	0.67	0
203	Ethanolamine	6.81	0
204	2-amino-2-methyl-1-propanol	0.25	0
205	1-Methyl-2-pyrrolidinone	2.41	0.0019
206	Isopropyl acetate	1.07	0.0085
207	Methyl amyl ketone	1.48	0.014

208	N-propyl alcohol	2.5	0
209	Cyclohexanol	1.95	0.022
210	Acetic acid	0.68	0
211	Isobutyl alcohol	2.51	0
212	Propylene carbonate	0.28	0
213	C9 ketones	1.08	0.029
214	Methyl ethyl ketoxime	1.58	0
215	Isobutyl isobutyrate	0.6	0.029
216	Ethyl-3-ethoxypropionate	3.58	0.038
217	Dimethyl succinate	0.23	0.038
218	Pentanedioic acid, dimethyl ester	0.42	0.029
219	Propylene glycol	2.58	0
220	Volatile methyl siloxanes	0	0.095
221	Ethylene glycol	3.13	0
222	2,2,4-trimethyl-1,3-pentanediol isobutyrate	0.81	0.0048
223	Carbitol	3.26	0.087
224	Dipropylene glycol	2.31	0.27
225	di(propylene glycol) methyl ether	1.98	0.12
226	butyl carbitol	2.39	0.16
227	Triethanolamine	4.21	0.34
228	Hexylene glycol	1.45	0.16
229	Diethanolamine	2.47	0
230	1,3-butylene glycol	3.36	0
231	Glycerol	3.15	0
232	Benzyl alcohol	5.11	0.09
233	Methyl carbitol	2.66	0.066
234	Propylene glycol butyl ether	2.72	0.068
235	Dibutyl phthalate	1.25	0.61
236	Phenoxyethanol	4.49	0.023
237	1-(2-butoxy-1-methylethoxy)-2-propanol	1.83	0.27
238	Diethylene glycol	3.35	0
239	dipropylene glycol monopropyl ether	2.68	0.21
240	Ethylene glycol propyl ether	3.3	0.039
241	dimethyl adipate	1.8	0.11
242	2-ethylhexyl benzoate	0.98	0.067
243	diacetone alcohol	0.6	0.067
244	1-phenoxy-2-propanol	1.6	0.036
245	triethylene glycol	3.25	0.36
246	C10 alkyl phenols	1.73	0.1
247	tripropylene glycol methyl ether	1.92	0.36
248	Propylene glycol n-propyl ether	2.68	0.052
	Halocarbons		
249	dichlorodifluoromethane	0	0
250	Chloromethane	0.038	0

251	trichlorofluoromethane	0	0
252	Dichloromethane	0.041	0
253	Trichloromethane	0.022	0
254	Carbon tetrachloride	0	0
255	trans-1,2-Dichloroethylene	1.7	0
256	1,1-Dichloroethane	0.069	0
257	1,2-Dichloroethane	0.21	0
258	Trichloroethylene	0.64	0
259	1,1,2-Trichloroethane	0.086	0
260	Perchloroethylene	0.031	0
261	1,2-Dichloroacetylene	0.17	0
262	1,2-Dichloropropane	0.29	0
263	1,3-Dichloro-1-propene	4.365	0
264	Hexachlorobutadiene	0.043	0
265	Chlorobenzene	0.32	0
266	1,3-Dichlorobenzene	0.178	0
267	1,4-Dichlorobenzene	0.178	0
268	1,2-Dichlorobenzene	0.178	0
269	1,2,4-trichlorobenzene	0.178	0
270	Benzyl chloride	4	0.09
271	P-chlorobenzotrifluoride	0.126	0
272	Carbon disulfide	0.25	0
273	1,1-Difluoroethane	0.0175	0
274	1,1-dichloro-1-fluoroethane	0.086	0
275	***Unspeciated*** (n-tetradecane)	*0*	*0.11*

Note: C ≥ 12 species are considered as S/IVOCs in this study.

Table S10 (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[a]

Table S10 (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[b]
Combination technologies [c]	12	63[d]
Absorption	11	20[b]
Combustion	2	78[b]
Plasma	2	30[b]
Photolysis	1	15[b]
Other technologies	3	43[b]

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 S11. 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 S12. 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 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. (2011b)	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
			Other industrial paint	375	g /kg paint	2.5

Reference	Base year and region	Emission sources		Emission factors	Units	Activity data sources or data (Tg)
		Adhesive	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^2	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
Sun et al. (2018)	2009-2013, China	Coating	Interior wall paint	80	g/kg paint	

<table>
<tr><th>Reference</th><th>Base year and region</th><th colspan="2">Emission sources</th><th>Emission factors</th><th>Units</th><th>Activity data sources or data (Tg)</th></tr>
<tr><td rowspan="13"></td><td rowspan="13"></td><td rowspan="5"></td><td>Exterior wall water paint</td><td>120 for waterborne, 450 for solvent-based</td><td>g/kg paint</td><td rowspan="13">China Statistical Yearbook, China Market Yearbooks, China Light Industry Yearbook, China Building Materials Industry Yearbook, China Industrial Economy Statistical Yearbook</td></tr>
<tr><td>Car</td><td>21.2</td><td>kg/car</td></tr>
<tr><td>Motorcycle</td><td>1.8</td><td>kg/motorcycle</td></tr>
<tr><td>Bicycle</td><td>0.3</td><td>kg/bicycle</td></tr>
<tr><td>Home appliance coating</td><td>0.2</td><td>kg/piece</td></tr>
<tr><td rowspan="2">Ink</td><td>Conventional printing</td><td>750</td><td>g/kg ink</td></tr>
<tr><td>New printing</td><td>100</td><td>g/kg ink</td></tr>
<tr><td rowspan="3">Pesticide</td><td>Insecticides</td><td>576</td><td>g/kg pesticide</td></tr>
<tr><td>Herbicides</td><td>276</td><td>g/kg pesticide</td></tr>
<tr><td>Bactericides</td><td>568</td><td>g/kg pesticide</td></tr>
<tr><td rowspan="2">Others</td><td>Decontamination and skimming</td><td>0.044</td><td>kg/capita</td></tr>
<tr><td>Consumer/commercial solvents</td><td>0.1</td><td>kg/capita</td></tr>
<tr style="display:none"></tr>
<tr><td rowspan="6">Li et al. (2019)/ MEIC [a]</td><td rowspan="6">1990-2017, China</td><td rowspan="6">Coating</td><td>architecture interior wall coating</td><td>180 for waterborne, 620 for solvent-based</td><td>g/kg</td><td rowspan="6">China Paint and Coatings Industry Annual</td></tr>
<tr><td>architecture other paint</td><td>300 for waterborne, 620 for solvent-based</td><td>g/kg</td></tr>
<tr><td>new car varnish paint</td><td>50 for waterborne, 730 for solvent-based</td><td>g/kg</td></tr>
<tr><td>vehicle refurnish paint</td><td>150 for waterborne, 750 for solvent-based</td><td>g/kg</td></tr>
<tr><td>decorations wood</td><td>225 for waterborne, 660 for solvent-based</td><td>g/kg</td></tr>
<tr><td>wood furniture</td><td>225 for waterborne, 660 for solvent-based</td><td>g/kg</td></tr>
</table>

Reference	Base year and region	Emission sources		Emission factors	Units	Activity data sources or data (Tg)
			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.

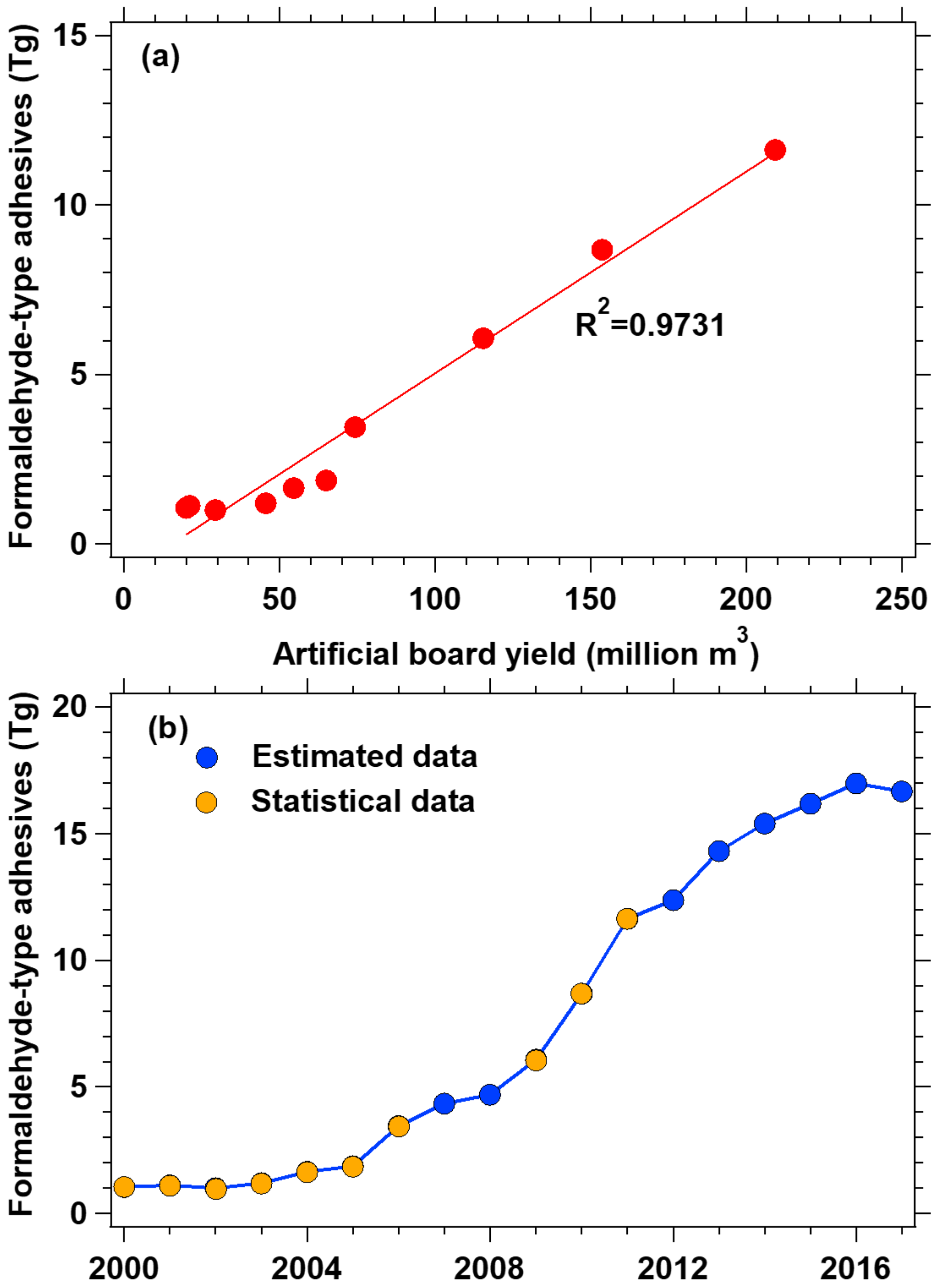


Figure S1. (a) The linear relationship between formaldehyde-type adhesive consumption and the artificial board yield for estimating consumption of formaldehyde-type adhesive, and (b) consumption of formaldehyde-type adhesive during 2000-2017.

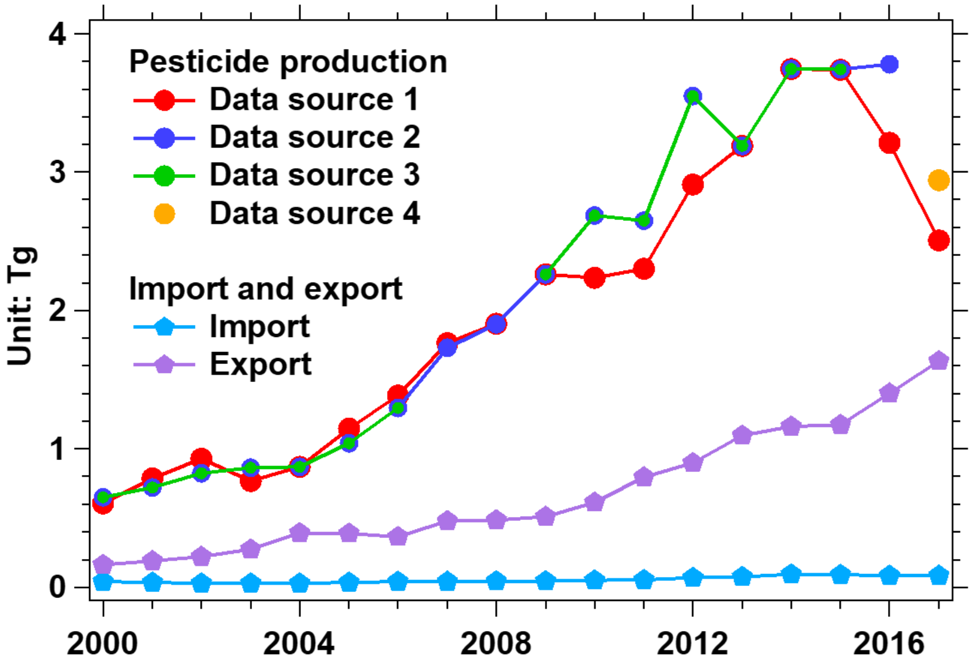


Figure S2. Pesticide production, import and export data during 2000-2017 in China. Data source 1: China Statistical Yearbook, missing import and export data; Data source 2: China Crop Protection Industry Yearbook; Data source 3: China Chemical Industry Yearbook; Data source 4: Duan (2018).

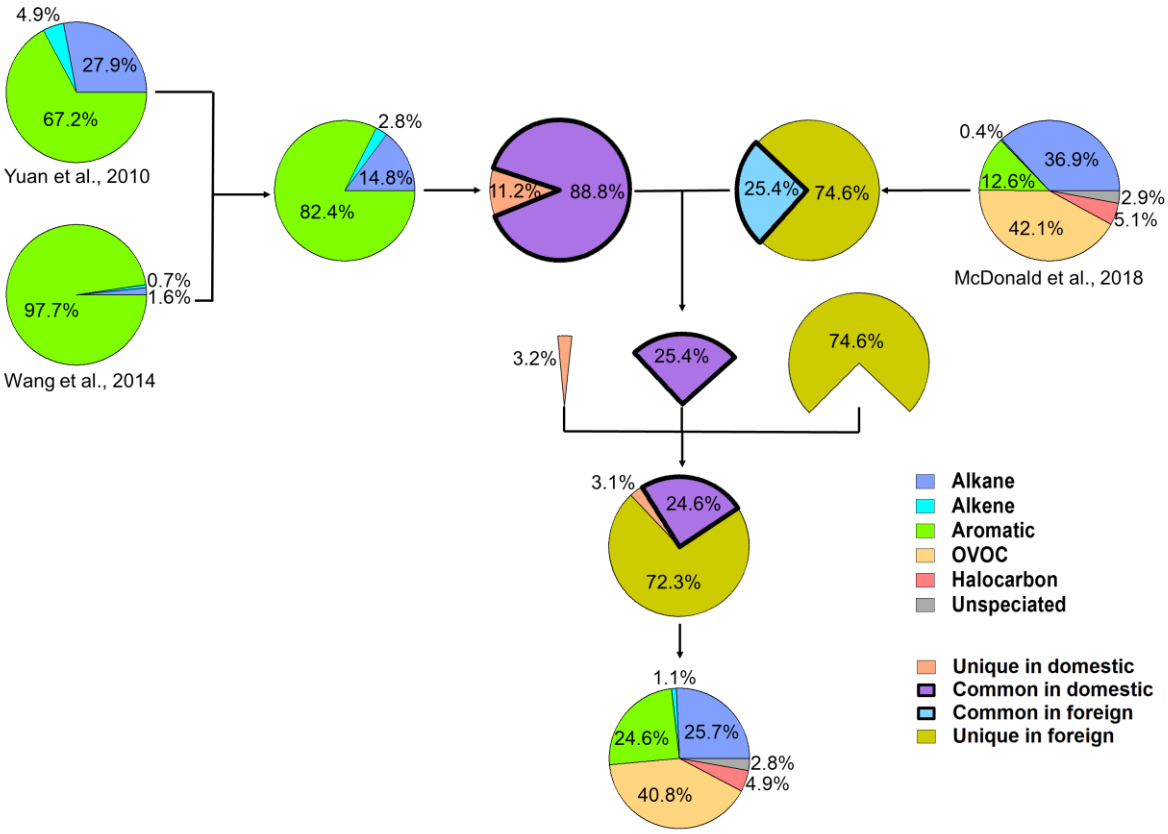


Figure S3. The procedure of obtaining merged source profiles for architectural coating.

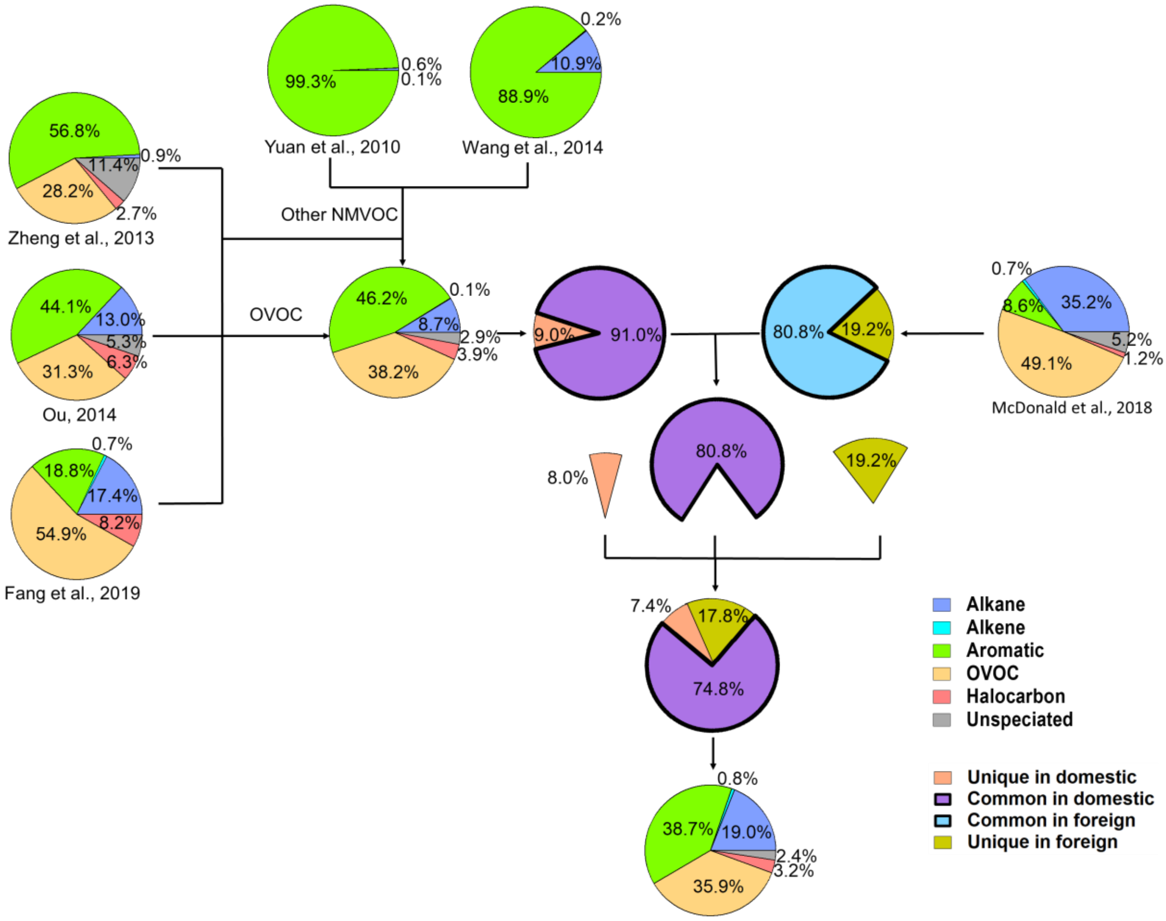


Figure S4. The procedure of obtaining merged source profiles for furniture coating.

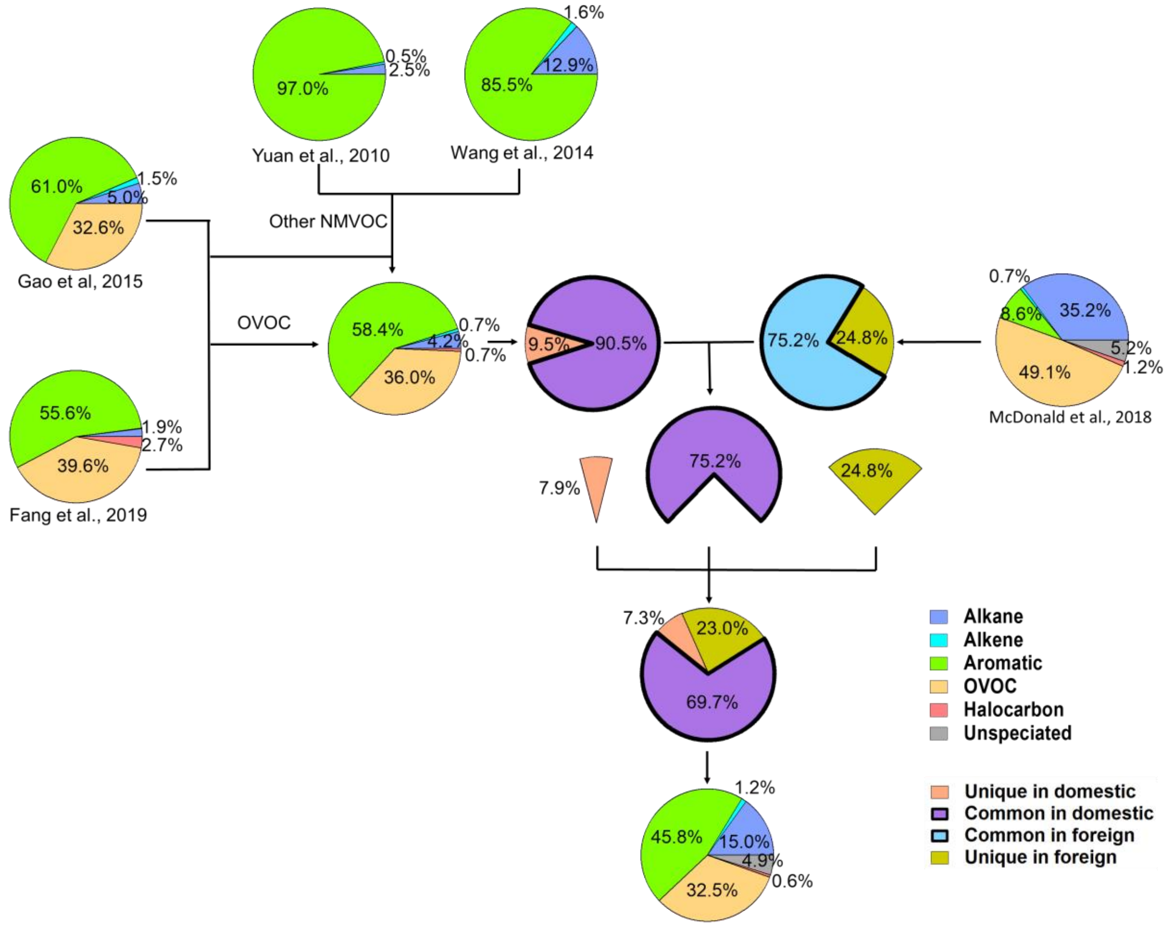


Figure S5. The procedure of obtaining merged source profiles for automobile coating.

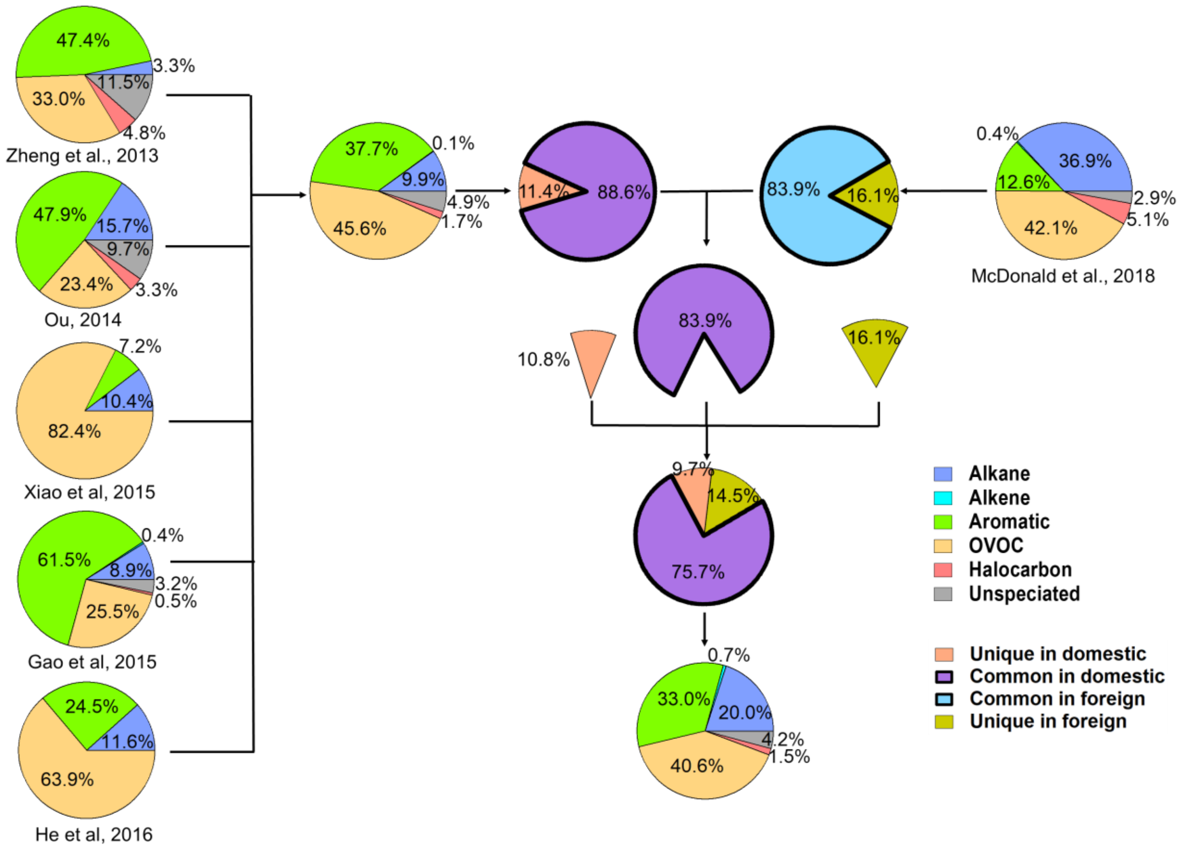


Figure S6. The procedure of obtaining merged source profiles for other industrial coating.

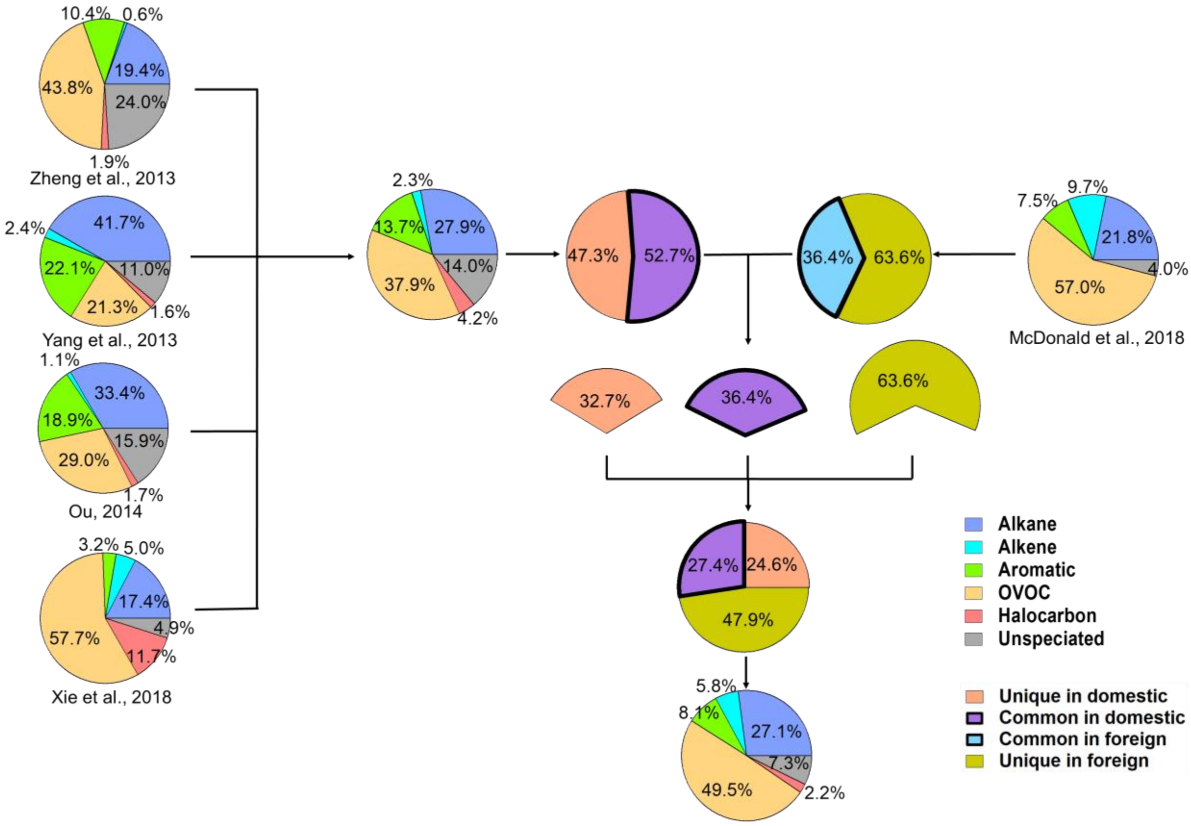


Figure S7. The procedure of obtaining merged source profiles for offset printing ink.

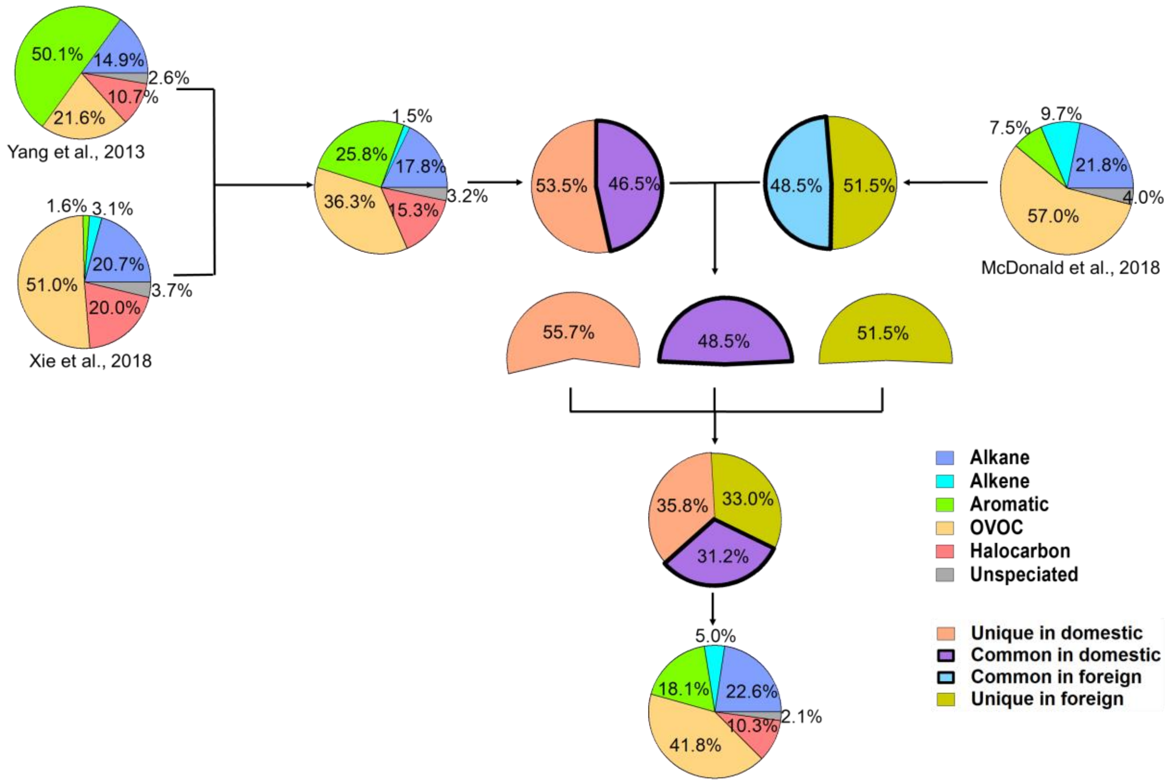


Figure S8. The procedure of obtaining merged source profiles for letterpress printing ink.

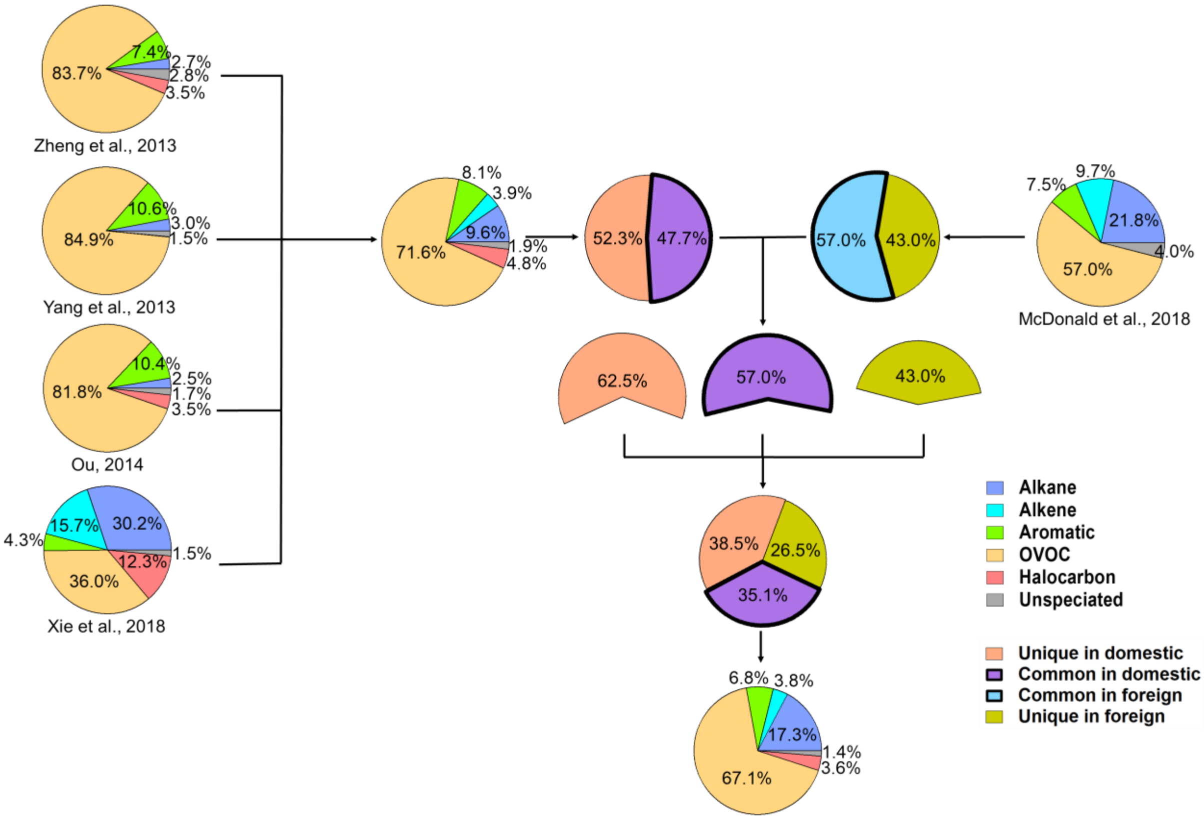


Figure S9. The procedure of obtaining merged source profiles for gravure printing ink.

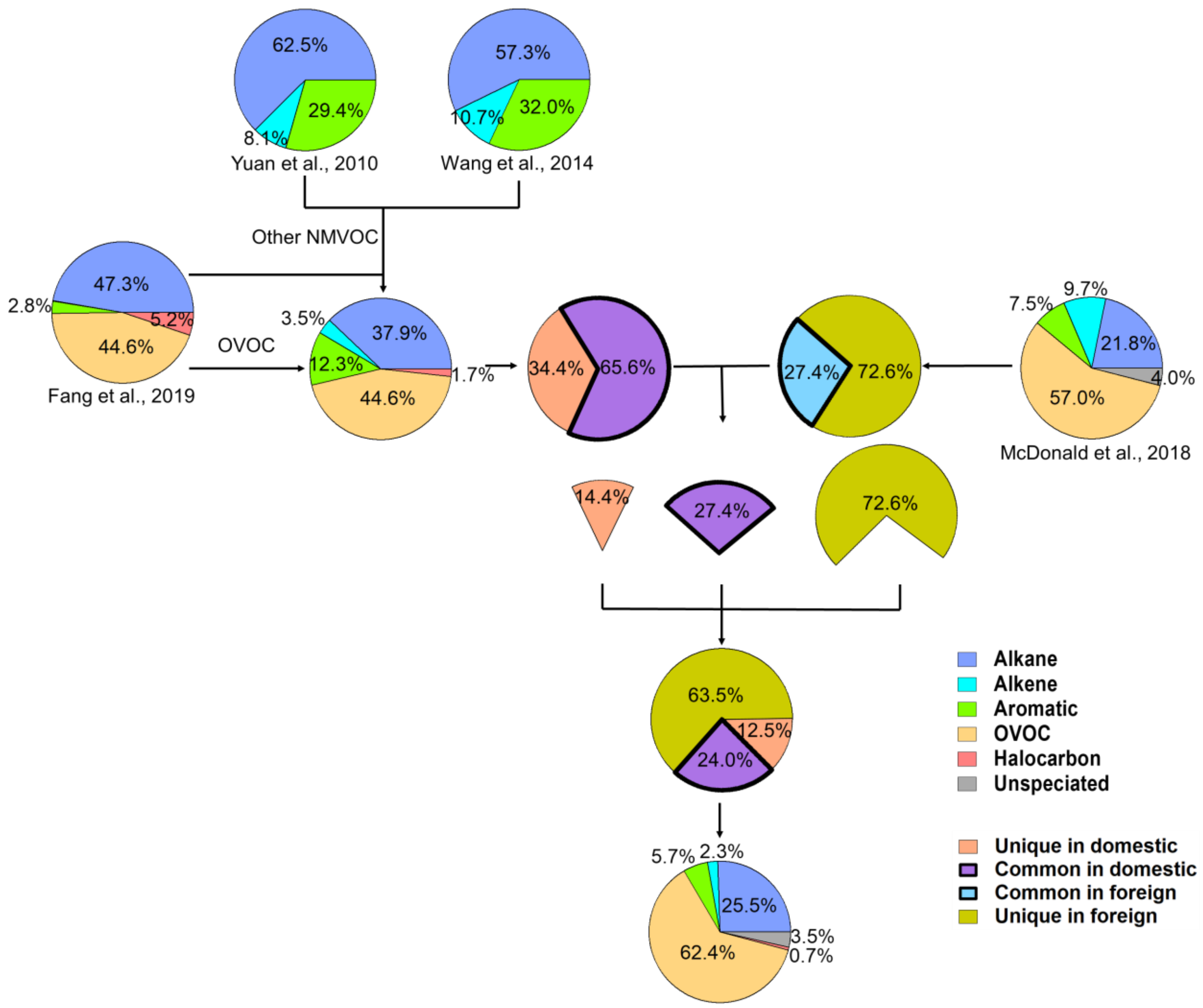


Figure S10. The procedure of obtaining merged source profiles for other printing ink.

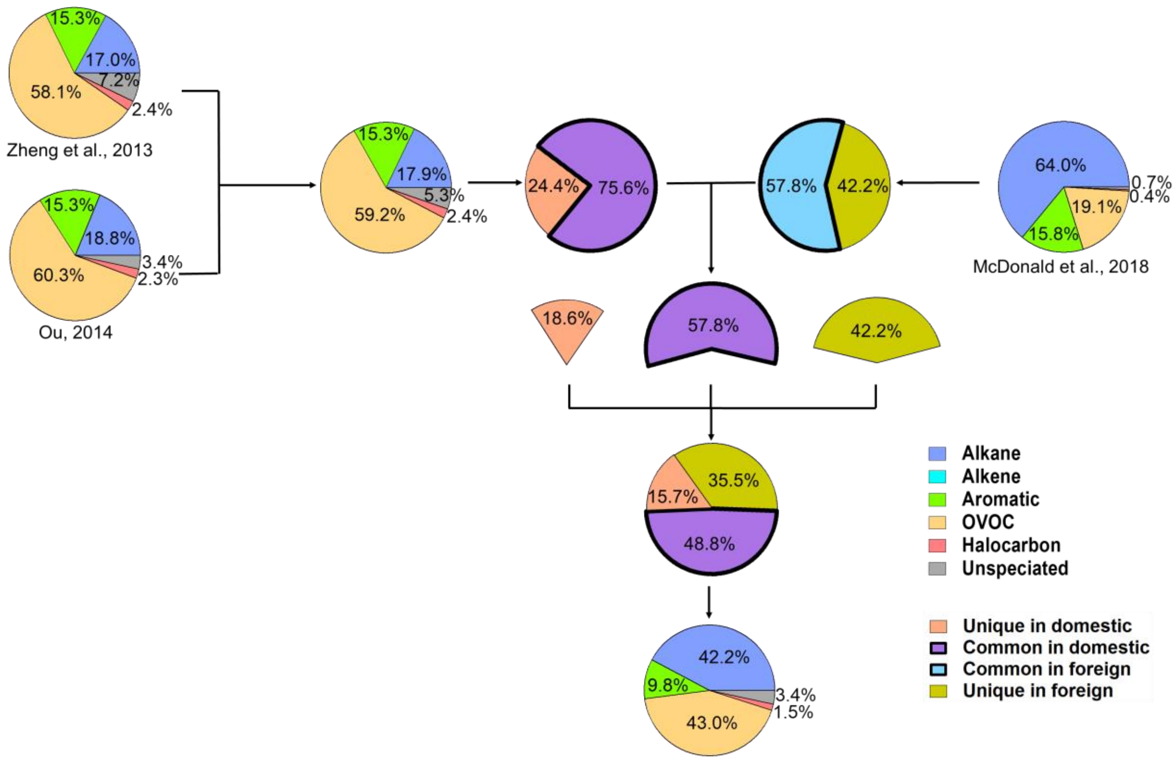


Figure S11. The procedure of obtaining merged source profiles for shoemaking adhesive.

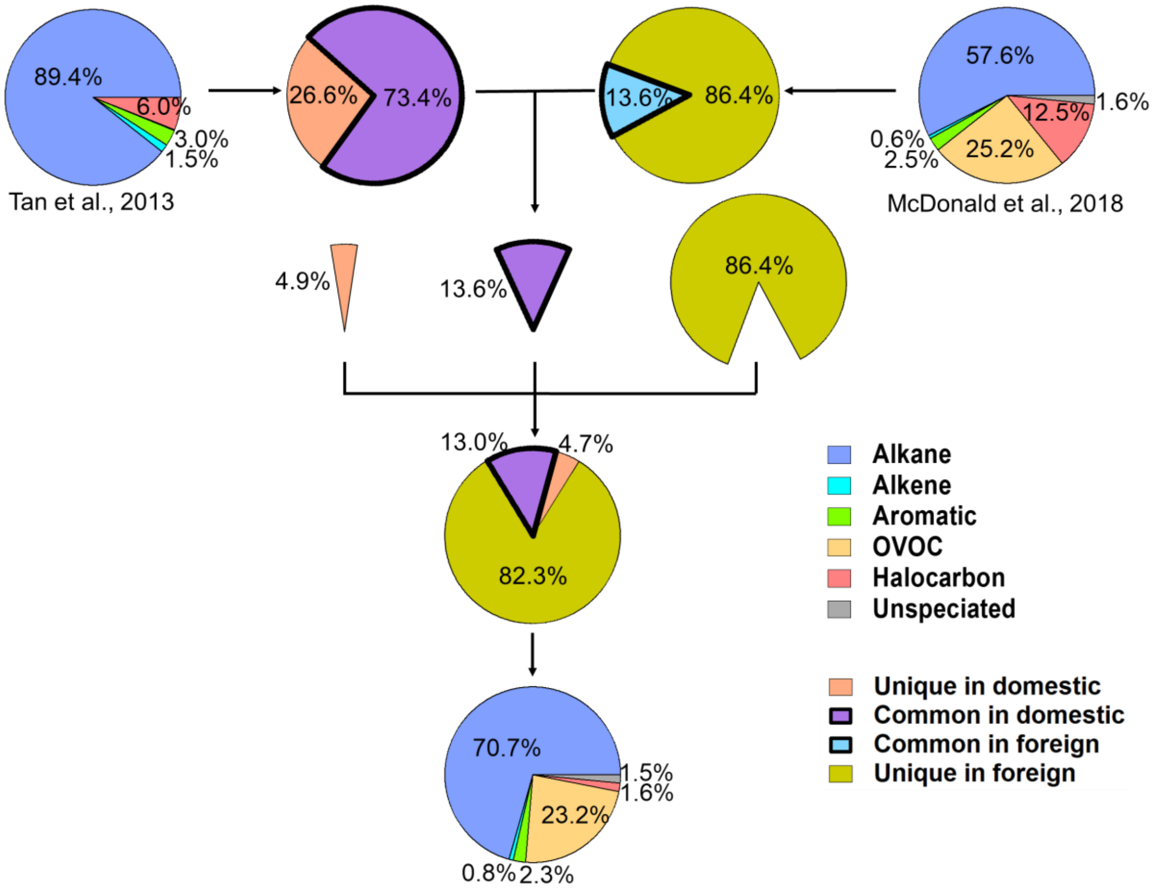


Figure S12. The procedure of obtaining merged source profiles for herbicide.

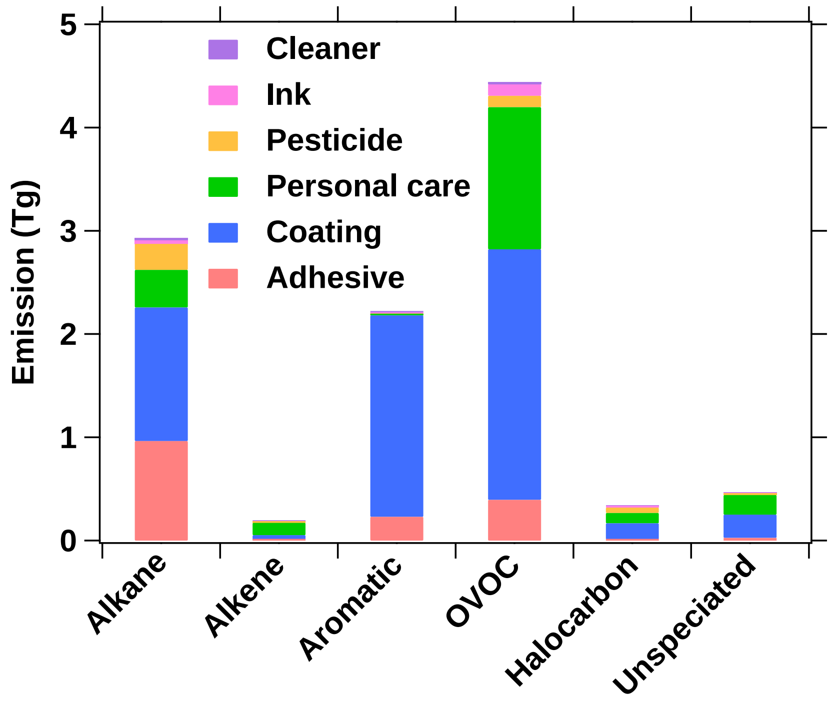


Figure S13. NMVOCs group emissions from various solvent categories in 2017.

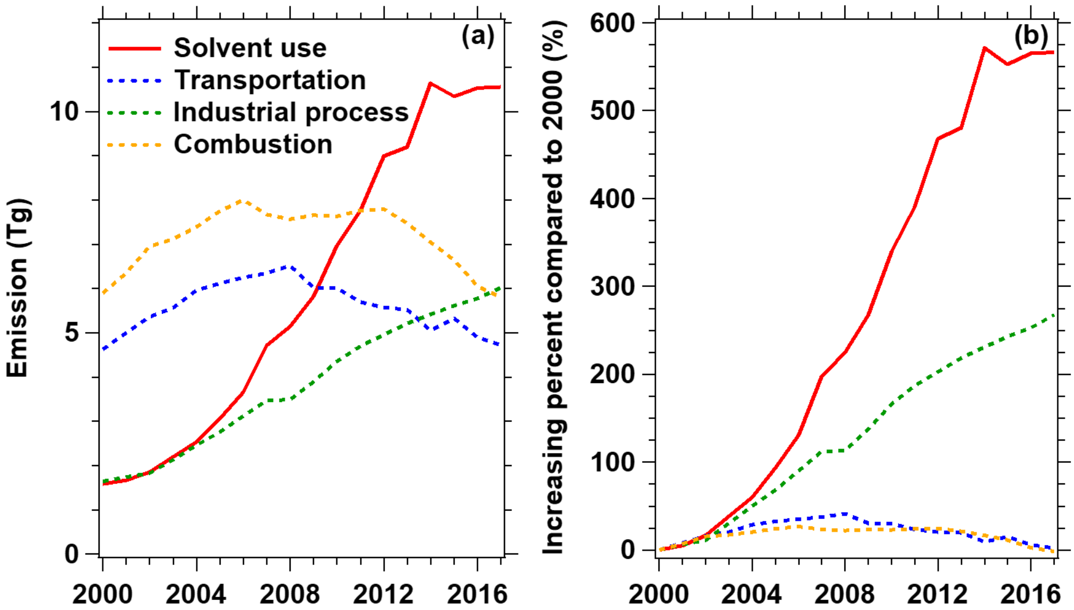


Figure S14. Comparisons of (a) NMVOCs emissions and (b) their increasing percentage compared to 2000 from solvent use (this study) and other sources (MEIC).

Reference

Bai, Shan, and Zi, Yin: Water-based ink market (in Chinese), China Printing Materials Market, 27-28, 2003.
Beijing Municipal Ecology and Environment Bureau: Detailed rules for the collection of pollutant discharge fees for volatile organic compounds, available at: http://sthjj.beijing.gov.cn/bjhrb/index/xxgk69/zfxxgk43/fdzdgknr2/hbjfw/604447/index.html, 2015.
Bo, Y., Cai, H., and Xie, S. D.: Spatial and temporal variation of historical anthropogenic NMVOCs emission inventories in China, Atmospheric Chemistry and Physics, 8, 7297-7316, 10.5194/acp-8-7297-2008, 2008.
Cai, Huihua: The progress of pollution control on stationary sources in Guangdong Province, Guangdong Polytechnic of Environmental Protection Engineering, Foshan, China, 2016.
California air resources board: Regulation for Reducing Emissions from Consumer Products, available at: https://ww3.arb.ca.gov/consprod/regs/2019/article_2_final_5_2019.pdf, 2019a.
California air resources board: Regulation for Reducing VOC Emissions from Antiperspirants and Deodorants, available at: https://ww3.arb.ca.gov/consprod/regs/2019/article_1_final_5_2019.pdf, 2019b.
China National Coatings Industry Association: The 13th Five-year Plan in Coatings Industry in China, China Coatings, 31, 1-12, 2016.
Chyxx: Competition pattern and demand market Outlook of Waterborne coatings industry in China in 2014, available at: http://www.chyxx.com/industry/201408/275519.html, 2014.
Chyxx: Analysis of the market demand for shoe adhesive in China in 2014, available at: http://www.chyxx.com/industry/201508/335107.html, 2015.
Chyxx: Ink industry market development status and future development trend analysis in 2016, available at: http://www.chyxx.com/industry/201702/494485.html, 2017.
Department of Ecology and Environment of Guangdong Province: Calculation method of volatile organic compounds emission in key industries, available at: http://gdee.gd.gov.cn/shbtwj/content/post_2305668.html, 2019.
Department of Ecology and Environment of Jiangsu Province: Interim Measures of Jiangsu Province for the Calculation of emissions of Volatile organic compounds in key Industries, available at: http://hbt.jiangsu.gov.cn/art/2016/7/8/art_1581_6691890.html, 2016.
Department of Ecology and Environment of Shandong Province: Reference value of organic material type and VOCs content, available at: http://xxgk.sdein.gov.cn/zfwj/lhh/201705/t20170508_1173844.html, 2017.
Department of Ecology and Environment of Zhejiang Province: Interim Method for the Calculation of Volatile Organic compounds (VOCs) emissions from industrial coating Process and Printing Industry, available at: http://sthjt.zj.gov.cn/art/2017/6/26/art_1229263559_2258845.html, 2017.
Duan, Yousheng: China's pesticide industry in 2017 (in Chinese), Economic Analysis of China Petroleum and Chemical Industry, 47-49, 2018.
DYQ: Urea formaldehyde resin details, available at: https://www.dyq.cn/show/42001485.html, 2019.
Fang, Li, Liu, Wen-wen, Chen, Dan-ni, Li, Guo-hao, Wang, Di, Shao, Xia, and Nie, Lei: Source Profiles of Volatile Organic Compounds(VOCs) from Typical Solvent-based Industries in Beijing (in Chinese), Environmental Science, 40, 4395-4403, 2019.
Gao, Zongjiang: Source chareteristics of VOC emission from typical industrial painting sources (MS thesis). South China University of Technology, 2015.
Green Seal: GS-50 Personal Care and Cosmetic Products, available at: https://greenseal.org/green-seal-standards/gs-50, 2020.
He, Menglin, Wang, Ni, Chen, Yangda, Wu, Zeng, Chen, Jiandong, Fan, Liya, and Ye, Daiqi: Emission characteristics of volatile organic compounds(VOCs) from electronic manufacturing factory of Guangdong

Province (in Chinese), Acta Scientiae Circumstantiae, 36, 1581-1588, 2016.
Henan River Grinding Material Co LTD: Phenolic resin details, available at: http://www.hnbhsy.com/photo/667.html;http://www.hnbhsy.com/photo/649.html, 2020.
Huaon: The current situation of Waterborne coatings industry in China in 2018, available at: https://www.huaon.com/story/446158, 2019.
Human Settlements and Environment Commission of Shenzhen Municipality: Limit of volatile organic compounds of industrial production and consumer goods available at: http://meeb.sz.gov.cn/attachment/0/321/321040/2039498.pdf, 2016.
Li, M., Zhang, Q., Streets, D. G., He, K. B., Cheng, Y. F., Emmons, L. K., Huo, H., Kang, S. C., Lu, Z., Shao, M., Su, H., Yu, X., and Zhang, Y.: Mapping Asian anthropogenic emissions of non-methane volatile organic compounds to multiple chemical mechanisms, Atmospheric Chemistry and Physics, 14, 5617-5638, 10.5194/acp-14-5617-2014, 2014.
Li, Meng, Zhang, Qiang, Zheng, Bo, Tong, Dan, Lei, Yu, Liu, Fei, Hong, Chao Peng, Kang, Si Cong, Yan, Liu, Zhang, Yu Xuan, Bo, Yu, Su, Hang, Cheng, Ya Fang, and He, Ke Bin: Persistent growth of anthropogenic non-methane volatile organic compound (NMVOC) emissions in China during 1990–2017: drivers, speciation and ozone formation potential, Atmospheric Chemistry and Physics, 19, 8897-8913, 10.5194/acp-19-8897-2019, 2019.
Liu, Guojie: Current situation and development trend of architectural coatings (in Chinese), Architecture Decoration, 6-7, 2000.
Lu, Jianhai, Dong, Shibi, Li, Wenjuan, Miu, Xiaoping, and Gu, Zhenyu: Present Situation of VOCs Control Technologies for the Industrial Coating Process in Zhejiang Province (in Chinese). Environmental Protection Science, 44, 113-117+121, 2018.

McDonald, Brian C., de Gouw, Joost A., Gilman, Jessica B., Jathar, Shantanu H., Akherati, Ali, Cappa, Christopher D., Jimenez, Jose L., Lee-Taylor, Julia, Hayes, Patrick L., McKeen, Stuart A., Cui, Yu Yan, Kim, Si-Wan, Gentner, Drew R., Isaacman-VanWertz, Gabriel, Goldstein, Allen H., Harley, Robert A., Frost, Gregory J., Roberts, James M., Ryerson, Thomas B., and Trainer, Michael: Volatile chemical products emerging as largest petrochemical source of urban organic emissions, Science, 359, 760, 10.1126/science.aaq0524, 2018.
National Bureau of Statistics: 2017 China Industrial Statistical Yearbook, China Statistics Press, Beijing, China, 2017.
National Bureau of Statistics: 2017 China Statistical Yearbook, China Statistics Press, Beijing, China, 2018.
Ou, Jiaming: Characterization and validation of Volatile Organic Compounds (VOCs) emission sources and reactivity-based control strategy in the Pearl Delta region (MS thesis). South China University of Technology, 2014.
Qianzhan: A panoramic map of China's ink industry in 2019, available at: https://www.qianzhan.com/analyst/detail/220/190618-27096aef.html, 2019.
Shanghai Municipal Bureau of Ecology and Environment: General method for calculating the emission of volatile organic compounds from industrial enterprises in Shanghai, available at: https://sthj.sh.gov.cn/hbzhywpt1133/hbzhywpt1135/20170308/0024-103293.html, 2017.

Sun, W., Shao, M., Granier, C., Liu, Y., Ye, C. S., and Zheng, J. Y.: Long-Term Trends of Anthropogenic SO2, NOx, CO, and NMVOCs Emissions in China, Earth's Future, 6, 1112-1133, 10.1029/2018ef000822, 2018.
VOCs.BJX: VOCs escape point, emission, concentration and characteristic pollutants in printing industry, available at: http://huanbao.bjx.com.cn/news/20190822/1001864.shtml, 2019.

Vzkoo: Hydrocarbon environmental protection solvent huge market potential, available at: https://www.vzkoo.com/news/815.html, 2019.
Wang, Hongli, Qiao, Yuezhen, Chen, Changhong, Lu, Jun, Dai, Haixia, Qiao, Liping, Lou, Shengrong, Huang, Cheng, Li, Li, Jing, Shengao, and Wu, Jianping: Source Profiles and Chemical Reactivity of Volatile Organic Compounds from Solvent Use in Shanghai, China, Aerosol and Air Quality Research, 14, 301-310, 10.4209/aaqr.2013.03.0064, 2014.
Wei, W., Wang, S., and Hao, J.: Uncertainty analysis of emission inventory for volatile organic compounds from anthropogenic sources in China (in Chinese). Environmental Science, 32, 305-312, 2011a.
Wei, Wei, Wang, Shuxiao, Hao, Jiming, and Cheng, Shuiyuan: Projection of anthropogenic volatile organic compounds (VOCs) emissions in China for the period 2010–2020, Atmospheric Environment, 45, 6863-6871, https://doi.org/10.1016/j.atmosenv.2011.01.013, 2011b.
Wu, R., and Xie, S.: Spatial Distribution of Ozone Formation in China Derived from Emissions of Speciated Volatile Organic Compounds, Environ Sci Technol, 51, 2574-2583, 10.1021/acs.est.6b03634, 2017.
Xiao, Jingfang, Ye, Daiqi, Liu, Qiao, Peng, Ruosi, and Wang, Guannan: Emission characteristics of volatile organic compounds (VOCs) from the manufacturing process of consumer electronic products (in Chinese), Acta Scientiae Circumstantiae, 35, 1612-1619, 2015.
Xie, Yisong, Zheng, Xinmei, and Liu, Chunlei: Source Profiles and Ozone Formation Potental of Volatile Organic Compounds from Printing Industry in Nanjing (in Chinese), Environmental Science and Technology, 31, 64-67, 2018.
Yang, Yang, Yang, Jing, Yin, Shasha, Yu, Yufan, Zheng, Jun-yu, and Mo, Ziwei: Speciated VOCs Emission Inventory and Key Species from Printing Industry in the Pearl River Delta Region (in Chinese), Research of Environmental Sciences, 26, 326-333, 2013.
Yin, S., Zheng, J., Lu, Q., Yuan, Z., Huang, Z., Zhong, L., and Lin, H.: A refined 2010-based VOC emission inventory and its improvement on modeling regional ozone in the Pearl River Delta Region, China, Sci Total Environ, 514, 426-438, 10.1016/j.scitotenv.2015.01.088, 2015.
Yuan, Bin, Shao, Min, Lu, Sihua, and Wang, Bin: Source profiles of volatile organic compounds associated with solvent use in Beijing, China, Atmospheric Environment, 44, 1919-1926, 10.1016/j.atmosenv.2010.02.014, 2010.
Yuan, Changbo, and Chen, Jincai: A new adhesive for shoes (in Chinese), China Adhesives, 32-33, 2005.
Zheng, J., Yu, Y., Mo, Z., Zhang, Z., Wang, X., Yin, S., Peng, K., Yang, Y., Feng, X., and Cai, H.: Industrial sector-based volatile organic compound (VOC) source profiles measured in manufacturing facilities in the Pearl River Delta, China, Sci Total Environ, 456-457, 127-136, 10.1016/j.scitotenv.2013.03.055, 2013.