

1 **Emission trends and mitigation options for air pollutants in**
 2 **East Asia**

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16 Table S 1 Penetrations of major control technologies for industrial process in China.

17 (1) SO₂

Industrial process	Control technology	Base year		BAU[0]/PC[0]		BAU[1]/PC[1]		BAU[2]/PC[2]
		2005	2010	2020	2030	2020	2030	2030
Sintering	FGD	0	10	20	40	95	100	100
Coke oven	FGD for coal filling process	0	0	0	0	10	10	0
	FGD for coke oven gas	0	0	0	0	10	10	0
	Combination of the technologies above	0	0	0	0	30	50	100
Glass production (float process)	FGD	0	0	0	0	50	90	100
Sulfuric acid production	Ammonia acid desulfurization method	0	0	0	0	40	80	100
Other industrial process	PRSO ₂ (70% efficiency)	0	0	0	0	0	0	100

18 Notes: FGD, flue gas desulfurization; PRSO₂, general SO₂ removal technology with 70% removal
 19 efficiency for industrial processes other than those listed above.

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21 (2) NO_x

Industrial process	Control technology	Base year		BAU[0]/PC[0]		BAU[1]/PC[1]		BAU[2]/PC[2]
		2005	2010	2020	2030	2020	2030	2030

Sintering	SNCR	0	0	0	0	36	54	20
	SCR	0	0	0	0	24	36	80
Precalcined cement kiln	LNB	30	35	35	35	30	25	0
	LNB+SNCR	0	0	0	0	30	45	0
	LNB+SCR	0	0	0	0	20	30	100
Glass production (float process)	OXFL	0	0	0	0	80	88	70
	SCR	0	0	0	0	10	12	30
Nitric acid (dual pressure process)	ABSP	10	12	12	12	18	18	18
	SCR	15	18	18	18	72	82	82
	ABSP+SCR	0	0	0	0	0	0	0
Nitric acid (other process)	ABSP	60	63	66	66	5	5	0
	SCR	30	32	34	34	15	15	0
	ABSP+SCR	0	0	0	0	80	80	100
Other industrial process	PRNOX (40% efficiency)	0	0	0	0	0	0	100

1 Notes: LNB, low NO_x burner; SCR, selective catalytic reduction; SNCR, selective non-catalytic reduction;
2 ABSP, absorption method; OXFL, oxy-fuel combustion technology; PRNOX, general NO_x removal
3 technology with 40% removal efficiency for industrial processes other than those listed above.

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5 (c) PM

Industrial process	Control technology	Base year		BAU[0]/PC[0]		BAU[1]/PC[1]		BAU[2]/PC[2]
		2005	2010	2020	2030	2020	2030	2030
Sintering (flue gas)	CYC	5	0	0	0	0	0	0
	WET	20	5	0	0	0	0	0
	ESP	65	75	80	80	70	60	0
	HED	10	20	20	20	30	40	100
Sintering (fugitive)	CMN	80	60	50	50	30	10	0
	HIEF	20	40	50	50	70	90	100
Blast furnace (flue gas)	WET	100	100	100	100	100	100	100
	ESP	100	100	100	100	100	100	100
Blast furnace (fugitive)	CMN	0	0	0	0	0	0	0
	HIEF	100	100	100	100	100	100	100
Basic oxygen furnace	ESP	40	30	20	20	10	0	0
	HED	60	70	80	80	90	100	100
Electric arc furnace	WET	60	30	20	20	0	0	0
	ESP	30	50	50	50	40	20	0
	HED	10	20	30	30	60	80	100
Casting (flue gas)	CYC	40	40	40	40	0	0	0
	WET	40	40	40	40	40	20	0
	ESP	20	20	20	20	60	80	0
	HED	0	0	0	0	0	0	100
Casting (fugitive)	CMN	70	70	50	50	50	30	0

	HIEF	10	30	50	50	50	70	100
Hot rolling	ESP	0	0	0	0	70	95	100
Cold rolling	HED	0	0	0	0	70	95	100
Coke oven	WET	100	100	100	100	50	30	0
	HED	0	0	0	0	50	70	100
Alumina production	ESP	35	30	30	30	20	0	0
	HED	65	70	70	70	80	100	100
Electrolytic aluminium production	CYC	40	30	30	30	0	0	0
	ESP	40	60	60	60	80	40	0
	HED	0	10	10	10	20	60	100
Copper production	WET	5	0	0	0	0	0	0
	ESP	35	30	20	20	20	0	0
	HED	60	70	80	80	80	100	100
Shaft cement kiln	CYC	13	0	0	0	0	0	0
	WET	41	5	0	0	0	0	0
	ESP	40	60	50	50	45	35	0
	HED	6	35	50	50	55	65	100
Precalcined cement kiln	WET	1	0	0	0	0	0	0
	ESP	52	40	35	30	20	5	0
	HED	47	60	65	70	80	95	100
Other rotary cement kiln	WET	13	0	0	0	0	0	0
	ESP	77	50	50	50	40	30	0
	HED	10	50	50	50	60	70	100
Glass production	CYC	5	0	0	0	0	0	0
	WET	25	20	20	20	0	0	0
	ESP	68	75	75	75	85	75	0
	HED	3	5	5	5	15	25	100
Brick production	CYC	40	30	30	30	20	0	0
	WET	8	20	20	20	40	50	0
	ESP	0	20	20	20	40	50	0
	HED	0	0	0	0	0	0	100
Lime production	CYC	50	40	35	30	35	30	0
	WET	28	30	30	30	30	30	0
	ESP	8	20	25	30	25	30	0
	HED	3	10	10	10	10	10	100

1 Notes: CYC, cyclone dust collector; WET, wet scrubber; ESP, electrostatic precipitator; HED, high
2 efficiency deduster; CMN, common control of fugitive emissions; HIEF, high-efficiency control of fugitive
3 emissions.

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5 (4) NMVOC

Industrial process	Control technology	Base year		BAU[0]/PC[0]		BAU[1]/PC[1]		BAU[2]/PC[2]
		2005	2010	2020	2030	2020	2030	2030
Hot rolling	No control	100	100	94	90	65	55	0
	Good housekeeping	0	0	6	10	35	45	100
Coke oven	No control	100	100	100	100	55	20	0

Refinery	End of pipe control measures	0	0	0	0	45	80	100
	No control	100	100	87	80	20	0	0
	Leak detection and repair program	0	0	10	15	30	15	0
	Covers on oil and water separators	0	0	3	5	10	5	0
Paint production	Combination of the above options	0	0	0	0	40	80	100
	No control	100	100	90	85	25	0	0
	Primary measures	0	0	10	15	45	50	5
	Primary and end of pipe measures	0	0	0	0	30	50	95
Adhesive production	No control	100	100	90	85	25	0	0
	Primary measures	0	0	10	15	45	50	5
	Primary and end of pipe measures	0	0	0	0	30	50	95
Ink production	No control	100	100	90	85	25	0	0
	Primary measures	0	0	10	15	45	50	5
	Primary and end of pipe measures	0	0	0	0	30	50	95
Synthesized rubber production	No control	100	100	94	90	30	5	0
	Substitution	0	0	6	10	20	20	0
	Incineration	0	0	0	0	30	35	0
	Combination of the above options	0	0	0	0	20	40	100
Tyres production	No control	100	100	94	90	30	5	0
	Primary measures	0	0	6	10	35	45	0
	Incineration	0	0	0	0	30	40	0
	Combination of the above options	0	0	0	0	5	10	100
Production of other rubber products	No control	100	100	94	90	30	5	0
	Primary measures	0	0	6	10	35	45	0
	Incineration	0	0	0	0	30	40	0
	Combination of the above options	0	0	0	0	5	10	100
Plant oil extraction	No control	95	90	84	80	20	0	0
	Activated carbon adsorption	5	10	13	15	50	50	0
	Schumacher type DTDC and activated carbon adsorption	0	0	3	5	25	35	0
	Schumacher type DTDC and new recovery section	0	0	0	0	5	15	100
Pharmacy	No control	100	100	90	85	15	0	0
	Primary measures and low-level end-of-pipe measures	0	0	10	15	50	30	0
	Primary measures and high-level end-of-pipe measures	0	0	0	0	35	70	100
Food industry	No control	100	100	100	100	100	100	40
	End of pipe control measures	0	0	0	0	0	0	60
Paper pulp production	No control	100	100	100	100	100	100	0
	End of pipe control measures	0	0	0	0	0	0	100
Crude oil exploitation	No control	100	100	100	100	100	100	50
	Improved ignition system on flares	0	0	0	0	0	0	0
	Alternatives and increased recovery for venting	0	0	0	0	0	0	50
Organic synthesis	No control	100	100	100	100	100	100	0
	Leak detection and repair program	0	0	0	0	0	0	20

	Flaring	0	0	0	0	0	0	30
	Add-on techniques mainly thermal and catalytic incineration	0	0	0	0	0	0	50
Gasoline storage	No control	100	95	75	60	25	0	0
	IFC (Internal floating covers or secondary seals)	0	5	25	40	75	100	100
Gasoline loading and unloading	No control	100	85	50	50	25	0	0
	Stage IA (Vapor recovery systems and modified loading techniques)	0	15	50	50	75	100	100
service station	No control	100	85	50	50	25	0	0
	Stage IB + Stage II (Improvement in service station tank and vapor balancing system between a vehicle and service station tank)	0	15	50	50	75	100	100
Crude oil storage and distribution	No control	100	100	100	100	75	50	0
	IFC + Stage IA + Stage IB + Storage II	0	0	0	0	25	50	100

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2 Table S 2 Penetrations of major control technologies for NMVOC emissions from solvent use

3 in China.

Solvent use type	Control technology	Base year		BAU[0]/PC[0]		BAU[1]/PC[1]		BAU[2]/PC[2]
		2005	2010	2020	2030	2020	2030	2030
Paint use in interior wall of buildings	No control (GB18582-2001)	100	0	0	0	0	0	0
	Decrease of solvent content--GB18582-2008	0	100	95	90	70	0	0
	Decrease of solvent content--2004/42/EC stage 1	0	0	5	10	30	80	0
	Decrease of solvent content--2004/42/EC stage 2	0	0	0	0	5	20	100
Paint use in external wall of buildings	No control (solvent-based paint)	81.5	78	72.5	68.5	70	50	0
	Substitution with water-based paint	18.5	22	27.5	32.5	30	50	100
Paint use in vehicle manufacturing	No control (water-based primer, solvent-based paint for other parts)	100	97	91	84	35	0	0
	Substitution with water-based paint	0	2	4	6	15	30	0
	Adsorption, incineration	0	1	5	10	40	65	0
	Substitution + adsorption, incineration	0	0	0	0	0	5	100
Paint use in vehicle refinishing	No control (solvent-based paint)	95	92.5	87.5	82.5	80	40	0
	Sustitution with high solids or water-based paint	5	7.5	12.5	17.5	20	60	100
Paint use in wood coating	No control (solvent-based paint)	93.5	89	79	69	50	15	0
	Incineration	0	0	2	4	15	25	20
	Substitution with high solids paint	2	4	8	12	15	25	20
	Substitution with water-based or UV paint	4.5	7	11	15	20	35	60
Paint use in coil coating	No control (solvent-based paint)	85	82.5	77.5	70	70	35	0
	Substitution with water-based paint	15	17.5	22.5	30	25	35	0

	Incineration	0	0	0	0	5	30	100
Paint use in marine coating	No control (solvent-based paint)	43.7	41	37	33	23	0	0
	Substitution with high solids paint	43.7	45	46	47	45	40	0
	Incineration	0	0	2	4	10	20	0
Paint use in container coating	High solids paint+incineration	0	0	0	0	5	20	60
	Substitution with water-based paint	12.6	14	15	16	17	20	40
	No control (solvent-based paint)	43.7	41	37	33	23	0	0
	Substitution with high solids paint	43.7	45	46	47	45	40	0
	Incineration	0	0	2	4	10	20	0
Paint use in other industrial protection	High solids paint+incineration	0	0	0	0	5	20	60
	Substitution with water-based paint	12.6	14	15	16	17	20	40
	No control (solvent-based paint)	87.4	85	79.5	72.5	50	5	0
	Substitution with high solids paint	0	1	3	5	15	20	0
	Incineration	0	0	2	4	10	30	0
Other paint use	High solids paint+incineration	0	0	0	0	5	20	60
	Substitution with water-based paint	12.6	14	17.5	22.5	20	25	40
	No control	100	97.5	92.5	87.5	90	80	50
	Substitution with high solids or water-based paint	0	2.5	7.5	12.5	10	20	50
Offset printing	No control (solvent-based ink)	94	90	85	80	60	15	0
	Substitution with water-based or UV ink	6	10	15	20	20	30	10
	Add-on control technology	0	0	0	0	20	55	90
Flexography and rotogravure printing (for packaging)	No control (solvent-based ink)	70	64	55	45	30	0	0
	Substitution with low solvent or water-based ink	30	35	40	45	40	30	0
	Add-on control technology	0	1	5	10	10	30	0
	Substitution + add-on control technology	0	0	0	0	20	40	100
Flexography and rotogravure printing (for publication)	No control (solvent-based ink)	90	85	80	75	62.5	5	0
	Substitution with low solvent or water-based ink	10	15	20	25	22.5	40	0
	Add-on control technology	0	0	0	0	15	50	0
	Substitution + add-on control technology	0	0	0	0	0	5	100
Screen printing	No control (solvent-based ink)	90	85	80	75	62.5	5	0
	Substitution with low solvent or water-based ink	10	15	20	25	22.5	40	0
	Add-on control technology	0	0	0	0	15	50	0
	Substitution + add-on control technology	0	0	0	0	0	5	100
Adhesive use in wood processing	No control	100	97.5	92.5	87.5	90	60	0
	Add-on control technology	0	2.5	7.5	12.5	10	40	100
Adhesive use in manufacturing of shoes	No control (solvent-based adhesive)	90	87	82.5	80	70	50	10
	Substitution with low solvent adhesive	10	13	17.5	20	30	50	90
	Add-on control technology	0	0	0	0	0	0	0
Other adhesive use	No control (solvent-based adhesive)	4	4	1	1	1	1	0
	Substitution with water-based dispersion adhesive	68	68	69	59	70	50	40
	Substitution with UV adhesive	28	28	30	40	30	50	60
Leather production	No control (the 2005 status)	100	98	94	90	65	20	0
	Substitution with water-based paint	0	1	3	5	10	20	10

	Add-on control technology	0	1	3	5	25	60	90
Application of pesticides	No control (traditional pesticides)	82	65	60	55	60	35	0
	Substitution with environmental pesticides	18	35	40	45	40	65	100
Wood-protection (not creosote)	No control	100	97	88	70	75	20	0
	Substitution with water-based preservatives	0	3	7	15	10	30	50
	Incineration	0	0	5	15	15	50	50
Dry cleaning	No control (open dry cleaning machine)	100	80	50	15	0	0	0
	Refrigeration compressor	0	10	30	50	50	0	0
	Conventional closed circuit machine	0	5	15	30	40	80	0
	Hydrocarbon machine	0	3	5	5	5	5	10
	New generation closed circuit machine	0	0	0	0	5	15	90
Degreasing	No control	90	87.5	77.5	67.5	65	10	0
	Add-on control technology	0	0	5	10	15	50	10
	Substitution with low-solvent degreaser	10	12.5	17.5	22.5	20	40	90

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2 Table S 3 NMVOC emission factors for solvent use in 2005 and 2010

Activity	2005	2010
paint--interior wall (g/kg)	200	120
paint--external wall (g/kg)	597	580
paint--manufacturing of vehicle (g/kg)	470	460
paint--wood coating (g/kg)	662	637
adhesive--wood processing (g/kg)	90	88
adhesive--manufacturing of shoes (g/kg)	684	664
ink--offset-printing (g/kg)	683	658
ink--flexography and rotogravure in the packaging (g/kg)	555	515
ink--rotogravure in publication (g/kg)	695	668
ink--screen printing (g/kg)	695	668
solvent--leather production (g/kg)	245	224

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