

China's plastic import ban increases prospects of environmental impact mitigation of plastic waste trade flow worldwide

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Supplementary Information

Table

Supplementary Table 1. The trade flows of global plastic waste market from Comtrade in Baseline Scenario (Unit: t). (Corresponding to Figure 1.)

<i>Exporter</i> / <i>Importer</i>		China	HK	Japan	USA	Europe 7						Southeast Asia 5					Rep. of Korea	Mexico	
						Germany	UK	Belgium	Spain	Italy	France	Netherlands	Thailand	Indonesia	Viet Nam	Malaysia			Philippines
China		-	3184175.95	886254.83	923632.15	646162.82	250897.51	156735.41	94609.23	65512.82	94057.74	75735.84	179284.22	135518.06	144236.28	112363.75	78434.85	169200.67	176279.98
HK		1596.15	-	565702.33	617155.36	218161.42	314871.38	102921.61	64400.91	28945.86	74226.33	83014.33	42709.20	6031.62	2564.16	29802.23	7324.76	23130.29	80515.24
Japan		166.73	291.84	-	1022.78	41.42	131.32	22.30	66.07	19.04	18.29	19.88	407.93	37.62	342.91	129.98	187.41	485.02	32.08
USA		11205.60	253.44	1464.73	-	17088.81	865.05	7240.96	574.81	9101.83	1937.62	740.24	3190.17	428.80	83.97	145.35	0.00	60.80	196139.03
Europe 7	Germany	65.40	16.13	52.89	444.71	-	21886.17	12690.01	4538.03	17219.74	52637.83	56769.02	14.43	6.95	5.74	10.43	0.00	5.68	208.77
	UK	983.76	70.95	3.64	376.45	11768.82	-	4701.95	2055.84	1589.38	8337.56	30454.74	5.87	34.91	12.47	16.69	3.03	2.43	1301.93
	Belgium	68.78	17.66	40.93	733.36	19693.76	4938.12	-	3316.50	3481.38	44212.85	64652.89	9.24	2.31	169.71	6.11	13.34	11.09	332.89
	Spain	6.55	0.00	51.92	1208.10	7097.77	2397.20	1171.51	-	7844.42	40966.99	5722.73	1.44	10.24	0.00	0.00	4.79	0.00	199.87
	Italy	49.56	5.94	24.52	490.28	18133.00	5536.21	13113.49	18300.14	-	61549.33	7332.30	16.56	87.61	0.00	5.62	47.83	2.97	83.74
	France	59.16	2.49	14.00	65.29	25031.83	12855.58	20799.92	3338.85	6663.28	-	13044.71	0.25	62.69	4.51	5.99	4.25	0.06	2025.04
Southeast Asia 5	Thailand	2403.39	2313.43	11954.30	7640.08	531.64	2848.23	1933.75	3984.13	38.33	593.53	21.78	-	130.74	604.51	4904.34	163.48	59.50	316.76
	Indonesia	237.68	254.63	525.01	40721.46	511.80	17226.87	2761.35	1336.03	110.90	110.13	663.37	5.76	-	197.80	8126.37	232.05	644.61	10571.53
	Viet Nam	125.06	87620.23	39209.54	28688.45	12279.63	23608.13	10232.66	13219.85	1779.51	1688.46	6128.33	10938.67	351.58	-	3450.21	512.63	10399.08	650.35
	Malaysia	2642.70	4773.11	19747.90	25603.06	27949.84	34249.27	6581.52	13421.61	648.60	1315.38	690.01	3325.32	1598.88	914.94	-	871.62	7481.40	2343.64
	Philippines	371.20	1467.83	538.64	1141.61	10.44	527.03	155.12	121.03	0.63	60.82	0.30	93.09	42.65	101.56	232.55	-	50.14	83.44
Rep. of Korea		1233.97	4298.79	40892.33	7713.79	1024.99	3178.26	2373.64	155.22	27.21	599.12	645.82	1127.42	2687.52	6399.48	2880.50	8021.28	-	1927.74
Mexico		57.54	2.51	2.54	22452.24	238.84	14.64	165.43	53.72	25.29	9.46	4.97	0.05	0.00	0.00	0.67	0.00	0.74	-

Supplementary Table 2. The trade flows of global plastic waste market from Comtrade in 2018 Scenario (Unit: t). (Corresponding to Figure 2.) *Data with the orange background were estimated on the basis of monthly data, mirror data, and others.

<i>Exporter</i> / <i>Importer</i>		China	HK	Japan	USA	Europe 7						Southeast Asia 5					Rep. of Korea	Mexico	
						Germany	UK	Belgium	Spain	Italy	France	Netherlands	Thailand	Indonesia	Viet Nam	Malaysia			Philippines
China		-	49858.28	45969.68	0.00	13486.19	13860.30	4686.96	17215.99	5552.81	2974.70	1076.81	26634.67	61220.42	33174.34	11514.47	19673.12	10617.24	3070.73
HK		15635.38	-	54299.49	0.00	72976.55	39783.61	23433.78	14234.68	1199.04	12626.63	8584.80	3549.82	640.67	2091.39	1827.17	1121.18	267.82	25910.36
Japan		1436.40	394.66	-	663.82	1136.18	41.33	20.00	171.89	0.11	50.01	0.02	851.08	24.96	231.58	2017.63	125.63	952.92	31.34
USA		11625.58	682.90	9172.71	-	12199.23	3437.91	7720.00	2265.87	4388.82	1441.74	354.55	7830.10	6106.69	2490.94	2376.22	3247.19	0.57	194974.64
Europe 7	Germany	284.72	0.00	3729.65	3458.58	-	22685.73	33015.68	12053.26	26719.02	36140.90	72150.70	48.75	23.40	0.00	1.07	0.00	0.00	21.65
	UK	1425.05	78.48	66.83	553.82	27033.61	-	5748.43	496.84	2277.67	18424.20	41558.27	1063.41	622.74	0.00	0.00	16.35	0.00	480.31

	Belgium	131.76	0.00	158.87	2832.39	25040.25	20699.46	-	1356.10	714.12	35793.13	53501.88	0.00	1600.07	31.01	4.80	0.00	285.91	89.36
	Spain	105.51	0.00	2211.04	5225.30	8903.91	13821.58	1993.50	-	17913.80	80663.01	2309.63	359.62	206.08	975.82	0.00	407.85	0.06	382.72
	Italy	0.00	0.00	558.22	447.99	19344.40	8164.86	12596.71	4980.87	-	114408.97	13081.59	252.15	1143.66	0.00	0.00	6.21	0.00	656.25
	France	101.18	0.00	209.49	0.00	25220.81	17587.38	32820.64	8475.83	8348.71	-	13569.36	0.00	20.00	0.00	60.25	0.00	0.00	2563.84
	Netherlands	209.78	96.09	1611.11	1865.27	121246.39	50841.96	154628.30	2640.54	700.89	36694.62	-	0.00	20.00	0.46	0.00	17.10	9.68	138.08
Southeast Asia 5	Thailand	19835.96	115001.23	187826.61	106929.19	2045.72	14379.92	331.73	13460.66	3628.90	676.75	53.02	-	2250.85	68.08	10132.64	836.44	6864.43	8165.70
	Indonesia	1747.41	4661.64	20449.54	27385.17	64458.92	71929.27	13835.20	4030.47	213.90	3293.98	24910.96	306.81	-	1.64	7218.53	162.50	600.15	1571.94
	Viet Nam	218.60	31750.91	123255.16	74433.85	56781.45	23422.60	27582.36	25049.40	5501.89	7511.82	14289.04	11516.16	3722.25	-	1528.75	4332.32	26129.18	1772.18
	Malaysia	7100.45	70634.43	220398.93	207044.51	131453.22	102087.61	33066.65	28748.06	12909.95	17681.83	8102.70	3132.81	5330.31	0.00	-	744.29	11111.56	20815.48
	Philippines	101.36	3382.13	11485.18	6530.44	433.64	1347.14	120.54	238.24	19.90	195.55	0.10	718.34	1151.01	0.00	45.01	-	8755.86	706.68
Rep. of Korea		2902.68	1196.48	101321.37	35510.22	7074.30	3967.92	7105.79	692.33	853.54	832.91	2562.90	27735.08	1663.89	15053.58	322.02	6843.16	-	2836.16
Mexico		151.51	0.00	0.00	46201.22	888.50	0.00	727.95	0.99	909.31	25.68	87.24	231.76	0.00	1.47	0.00	5.20	20.00	-

Supplementary Table 3. The data of ED and TFCR of exports. (Corresponding to Figure 3.)

Countries and regions	HK	Japan	USA	Germany	UK	Belgium	Spain	Italy	France	Netherlands	Thailand	Indonesia	Viet Nam	Malaysia	Philippines	Rep. of Korea	Mexico
Total export flow of Baseline (t)	3290609.84	1657497.37	1979033.84	1363297.61	785685.89	437973.55	261225.50	219580.12	469302.57	413033.14	252411.03	148832.98	162611.90	176027.96	107699.82	212952.97	488776.15
ED	96.77%	87.60%	77.86%	63.40%	72.01%	59.29%	60.87%	43.02%	35.86%	38.44%	87.95%	95.11%	90.28%	80.76%	79.63%	90.32%	52.54%
TFCR of exports	-0.9125	-0.3918	-0.5409	-0.2339	-0.1873	0.2119	-0.3364	-0.1024	-0.0572	-0.1635	-0.2448	-0.3381	-0.6375	-0.7380	-0.3954	-0.6831	-0.3679

Supplementary Table 4. The proportion of types of plastics and three common treatment options for plastic waste.

Country or region	Proportion of plastic types (PE: PS: PVC: PET: PP: other)						Proportion of plastic waste treatments (Landfill or mismanagement: Incineration: Recycling)					
							Baseline			2018		
China mainland	0.170: 0.019: 0.145: 0.233: 0.140: 0.293	1	0.695: 0.116: 0.189	1	0.676: 0.124: 0.200	1						
Hong Kong, China	0.462: 0.048: 0.041: 0.183: 0.266: 0	2	0.550: 0.255: 0.195	3	0.550: 0.255: 0.195	3						
Japan	0.231: 0.073: 0.158: 0.037: 0.221: 0.280	4	0.080: 0.670: 0.250	5	0.060: 0.660: 0.280	6						
USA	0.386: 0.083: 0.038: 0.118: 0.185: 0.190	7	0.754: 0.155: 0.091	8	0.758: 0.158: 0.084	9						
Germany	0.298: 0.066: 0.102: 0.074: 0.193: 0.267	10	0.005: 0.605: 0.390	11	0.010: 0.610: 0.380	12						
The UK	0.298: 0.066: 0.102: 0.074: 0.193: 0.267	10	0.290: 0.390: 0.320	11	0.220: 0.470: 0.310	12						
Belgium	0.298: 0.066: 0.102: 0.074: 0.193: 0.267	10	0.020: 0.650: 0.330	11	0.020: 0.650: 0.330	12						
Spain	0.298: 0.066: 0.102: 0.074: 0.193: 0.267	10	0.480: 0.150: 0.370	11	0.390: 0.190: 0.420	12						
Italy	0.298: 0.066: 0.102: 0.074: 0.193: 0.267	10	0.370: 0.340: 0.290	11	0.370: 0.320: 0.310	12						
France	0.298: 0.066: 0.102: 0.074: 0.193: 0.267	10	0.340: 0.430: 0.230	11	0.340: 0.420: 0.240	12						
Netherlands	0.298: 0.066: 0.102: 0.074: 0.193: 0.267	10	0.010: 0.660: 0.330	11	0.000: 0.670: 0.330	12						
Thailand	0.462: 0.048: 0.041: 0.183: 0.266: 0	2	0.754: 0.030: 0.216	13,14	0.754: 0.030: 0.216	13,14						
Indonesia	0.462: 0.048: 0.041: 0.183: 0.266: 0	2	0.827: 0.021: 0.152	13,14	0.827: 0.021: 0.152	13,14						
Viet Nam	0.462: 0.048: 0.041: 0.183: 0.266: 0	2	0.879: 0.015: 0.106	13,14	0.879: 0.015: 0.106	13,14						
Malaysia	0.462: 0.048: 0.041: 0.183: 0.266: 0	2	0.570: 0.052: 0.378	13,14	0.570: 0.052: 0.378	13,14						
Philippines	0.462: 0.048: 0.041: 0.183: 0.266: 0	2	0.827: 0.021: 0.152	13,14	0.827: 0.021: 0.152	13,14						
Rep. of Korea	0.462: 0.048: 0.041: 0.183: 0.266: 0	2	0.241: 0.379: 0.380	15	0.241: 0.379: 0.380	15						
Mexico	0.462: 0.048: 0.041: 0.183: 0.266: 0	2	0.950: 0.000: 0.050	16	0.950: 0.000: 0.050	16						
Other Countries	0.462: 0.048: 0.041: 0.183: 0.266: 0	2	0.550: 0.255: 0.195	3	0.550: 0.255: 0.195	3						

Supplementary Table 5. EIT and Eco-costs of the China ban for 2018 Scenario. (Corresponding to Figure 5.)

Indicator	Unit		Eco-costs value (Euro/kg)	EIT				Eco-costs (Euro)			
				Total	(DM)	(Exp)	(tran)	Total	(DM)	(Exp)	(tran)
global warming (GW)	kg CO2 eq	(unspecified)	1.16E-01	1.3420E+08	2.0220E+09	-6.2736E+08	-1.2605E+09	1.5567E+07	2.3456E+08	-7.2774E+07	-1.4621E+08
fine particulate matter formation (FPMF)	kg PM2.5 eq	high. pop.	6.69E+01					-3.5350E+08	-2.3535E+08	1.9600E+08	-3.1415E+08
		(unspecified)	3.50E+01	-5.2880E+06	-3.5206E+06	2.9319E+06	-4.6993E+06	-1.8508E+08	-1.2322E+08	1.0262E+08	-1.6448E+08
		low. pop.	3.19E+00					-1.6869E+07	-1.1231E+07	9.3527E+06	-1.4991E+07
freshwater ecotoxicity (FWE)	kg 1,4DCB-eq to fresh water	(unspecified)	3.37E-02	-5.6537E+07	8.3346E+08	-8.8261E+08	-7.3850E+06	-1.9048E+06	2.8080E+07	-2.9736E+07	-2.4881E+05
		ocean	2.29E-05					-1.2964E+03	1.9111E+04	-2.0238E+04	-1.6933E+02
human carcinogenic toxicity (HCT)	kg 1,4DCB-eq to urban air	high. pop.	2.50E-01					-6.1719E+06	-1.4339E+07	9.6313E+06	-1.4638E+06
		(unspecified)	1.67E-01	-2.4664E+07	-5.7302E+07	3.8488E+07	-5.8496E+06	-4.1070E+06	-9.5420E+06	6.4091E+06	-9.7408E+05
		low. pop.	8.25E-02					-2.0354E+06	-4.7288E+06	3.1762E+06	-4.8273E+05
water consumption (WC)	m3	(unspecified)	6.60E-01	-3.2900E+09	-4.0813E+09	9.8747E+08	-1.9613E+08	-2.1714E+09	-2.6937E+09	6.5173E+08	-1.2945E+08
Eco-costs	Euro	(Max)						-2.5174E+09	-2.6807E+09	7.5485E+08	-5.9152E+08
								-2.3469E+09	-2.5638E+09	6.5825E+08	-4.4136E+08
		(Min)						-2.1747E+09	-2.4751E+09	5.9147E+08	-2.9114E+08

Supplementary Table 6. The unit values on GW of countries with different incineration rates and per capita GDP. (The data of Per capita GDP are from the World Bank- <https://data.worldbank.org/cn/>)

Countries	China	HK, China	Japan	USA	Germany	UK	Belgium	Spain	Italy	France	Netherlands	Thailand	Indonesia	Viet Nam	Malaysia	Philippines	Rep. of Korea	Mexico
Incineration rate in 2018	0.124	0.255	0.660	0.158	0.610	0.470	0.650	0.190	0.320	0.420	0.670	0.030	0.021	0.015	0.052	0.021	0.379	0.000
Per capita GDP in 2018 (Unchanged dollar in 2010)	7,755.00	38,784.80	48,919.60	54,541.70	47,501.80	42,986.00	46,683.20	33,146.40	35,391.70	43,663.60	55,022.90	6,361.60	4,284.70	1,964.50	12,109.50	3,022.00	26,761.90	10,385.30
Unit impact values of domestic management in 2018 on GW (kg CO ₂ eq / 1 kg plastic waste)	-0.04922	0.21615	0.88237	0.27757	0.56220	0.44472	0.86006	-0.31868	0.15707	0.60528	0.76390	-0.14075	-0.05690	0.00404	-0.35410	-0.05690	0.19529	0.05311

Supplementary Table 7. Sensitivity analysis of some parameters of LCA in 2018 Scenario.

Parameter		EIT					EIT(DM)					EIT(Exp)					EIT(tran)				
		GW	FPMF	FEW	HCT	WC	GW	FPMF	FEW	HCT	WC	GW	FPMF	FEW	HCT	WC	GW	FPMF	FEW	HCT	WC
		(kg CO ₂ eq)	(kg PM2.5 eq)	(kg 1,4-DCB)	(kg 1,4-DCB)	(m ³)	(kg CO ₂ eq)	(kg PM2.5 eq)	(kg 1,4-DCB)	(kg 1,4-DCB)	(m ³)	(kg CO ₂ eq)	(kg PM2.5 eq)	(kg 1,4-DCB)	(kg 1,4-DCB)	(m ³)	(kg CO ₂ eq)	(kg PM2.5 eq)	(kg 1,4-DCB)	(kg 1,4-DCB)	(m ³)
Road transportation distance	50 km	2.18E+08	-5.25E+06	-5.49E+07	-1.95E+07	-3.09E+09	1.98E+09	-3.64E+06	8.33E+08	-5.73E+07	-4.08E+09	-5.64E+08	3.01E+06	-8.82E+08	4.11E+07	1.09E+09	-1.20E+09	-4.62E+06	-6.44E+06	-3.25E+06	-9.81E+07
	100 km	1.34E+08	-5.29E+06	-5.65E+07	-2.47E+07	-3.29E+09	2.02E+09	-3.52E+06	8.33E+08	-5.73E+07	-4.08E+09	-6.27E+08	2.93E+06	-8.83E+08	3.85E+07	9.87E+08	-1.26E+09	-4.70E+06	-7.39E+06	-5.85E+06	-1.96E+08
	200 km	-3.28E+07	-5.36E+06	-5.98E+07	-3.50E+07	-3.68E+09	2.11E+09	-3.29E+06	8.34E+08	-5.72E+07	-4.08E+09	-7.54E+08	2.78E+06	-8.84E+08	3.33E+07	7.91E+08	-1.39E+09	-4.85E+06	-9.27E+06	-1.10E+07	-3.92E+08
Unit avoided electricity /1 kg	0.85 kWh	1.43E+08	-5.33E+06	-5.58E+07	-2.35E+07	-3.04E+09	2.11E+09	-3.34E+06	8.34E+08	-5.51E+07	-3.81E+09	-7.04E+08	2.71E+06	-8.83E+08	3.75E+07	9.68E+08	-1.26E+09	-4.70E+06	-7.39E+06	-5.85E+06	-1.96E+08
	0.9 kWh	1.34E+08	-5.29E+06	-5.65E+07	-2.47E+07	-3.29E+09	2.02E+09	-3.52E+06	8.33E+08	-5.73E+07	-4.08E+09	-6.27E+08	2.93E+06	-8.83E+08	3.85E+07	9.87E+08	-1.26E+09	-4.70E+06	-7.39E+06	-5.85E+06	-1.96E+08
	0.95 kWh	1.26E+08	-5.24E+06	-5.73E+07	-2.59E+07	-3.54E+09	1.94E+09	-3.70E+06	8.33E+08	-5.95E+07	-4.35E+09	-5.50E+08	3.16E+06	-8.82E+08	3.94E+07	1.01E+09	-1.26E+09	-4.70E+06	-7.39E+06	-5.85E+06	-1.96E+08

Unit avoided plastic production /1 kg	0.86 kg	1.67E+08	-5.26E+06	-5.64E+07	-2.38E+07	-3.28E+09	2.19E+09	-3.38E+06	8.34E+08	-5.30E+07	-4.00E+09	-7.62E+08	2.82E+06	-8.83E+08	3.51E+07	9.19E+08	-1.26E+09	-4.70E+06	-7.39E+06	-5.85E+06	-1.96E+08
	0.91 kg	1.34E+08	-5.29E+06	-5.65E+07	-2.47E+07	-3.29E+09	2.02E+09	-3.52E+06	8.33E+08	-5.73E+07	-4.08E+09	-6.27E+08	2.93E+06	-8.83E+08	3.85E+07	9.87E+08	-1.26E+09	-4.70E+06	-7.39E+06	-5.85E+06	-1.96E+08
	0.96 kg	1.02E+08	-5.31E+06	-5.67E+07	-2.55E+07	-3.30E+09	1.85E+09	-3.66E+06	8.33E+08	-6.16E+07	-4.16E+09	-4.92E+08	3.05E+06	-8.82E+08	4.19E+07	1.06E+09	-1.26E+09	-4.70E+06	-7.39E+06	-5.85E+06	-1.96E+08
Unit electricity consumption /1 kg	0.55 kWh	1.51E+08	-5.20E+06	-5.69E+07	-2.51E+07	-3.44E+09	1.96E+09	-3.67E+06	8.33E+08	-5.89E+07	-4.26E+09	-5.45E+08	3.16E+06	-8.82E+08	3.96E+07	1.02E+09	-1.26E+09	-4.70E+06	-7.39E+06	-5.85E+06	-1.96E+08
	0.6 kWh	1.34E+08	-5.29E+06	-5.65E+07	-2.47E+07	-3.29E+09	2.02E+09	-3.52E+06	8.33E+08	-5.73E+07	-4.08E+09	-6.27E+08	2.93E+06	-8.83E+08	3.85E+07	9.87E+08	-1.26E+09	-4.70E+06	-7.39E+06	-5.85E+06	-1.96E+08
	0.65 kWh	1.17E+08	-5.37E+06	-5.62E+07	-2.42E+07	-3.14E+09	2.09E+09	-3.37E+06	8.34E+08	-5.57E+07	-3.90E+09	-7.09E+08	2.70E+06	-8.83E+08	3.74E+07	9.54E+08	-1.26E+09	-4.70E+06	-7.39E+06	-5.85E+06	-1.96E+08

$$\text{Sensitivity coefficient} = \left(\frac{\Delta EIT_i}{EIT_i} \right) / \left(\frac{\Delta \text{Parameter}_i}{\text{Parameter}_i} \right)$$

Road transportation distance	-1.24	0.01	0.06	0.42	0.12	0.04	-0.07	0.00	0.00	0.00	0.20	-0.05	0.00	-0.14	-0.20	0.10	0.03	0.26	0.89	1.00
Unit avoided electricity	-1.15	-0.15	0.23	0.89	1.36	-0.76	0.93	-0.02	0.68	1.18	-2.21	1.38	0.00	0.45	0.36	0.00	0.00	0.00	0.00	0.00
Unit avoided plastic production	-4.43	0.09	0.05	0.64	0.07	-1.51	0.72	-0.02	1.36	0.36	-3.92	0.70	-0.02	1.62	1.25	0.00	0.00	0.00	0.00	0.00
Unit electricity consumption	-1.54	0.20	-0.08	-0.23	-0.55	0.38	-0.50	0.01	-0.33	-0.54	1.57	-0.95	0.00	-0.34	-0.41	0.00	0.00	0.00	0.00	0.00

Supplementary Table 8. Data of environmental impacts used in LCA of plastic waste trade flow change.

Data of	Selected datasets (“products” or “processes” in SimaPro)	Source database
Transportation	Road Transport, lorry >32t, EURO5/RER U; Transport, lorry 16-32t, EURO5/RER U; Transport, lorry 3.5-16t, fleet average/RER U; Transport, refuse truck, diesel powered/tkm/RNA	Ecoinvent unit processes USLCI
	Ocean Transport, ocean freighter, average fuel mix/US	USLCI
Waste treatment	Landfill Waste plastic, mixture treatment of, sanitary landfill APOS, U; Waste polyethylene treatment of, sanitary landfill APOS, U; Waste polyethylene terephthalate treatment of, sanitary landfill APOS, U; Waste polypropylene treatment of, sanitary landfill APOS, U; Waste polystyrene treatment of, sanitary landfill APOS, U; Waste polyvinylchloride treatment of, sanitary landfill APOS, U; Incineration Treatment of waste plastic, mixture, municipal incineration APOS, U; Treatment of waste polyethylene, municipal incineration APOS, U; Treatment of waste polyethylene terephthalate, municipal incineration with fly ash extraction APOS, U; Treatment of waste polypropylene, municipal incineration APOS, U; Treatment of waste polystyrene, municipal incineration APOS, U; Treatment of waste polyvinylchloride, municipal	Ecoinvent – allocation at point of substitution – unit

	incineration APOS, U. (each process has two versions: Europe without Switzerland and RoW)	
Electricity	Electricity, medium voltage, at grid/CN U (China) and national grid data of Japan (JP), the U.S. (US), Germany (DE), the UK (GB), Belgium (BE), Spain (ES), Italy (IT), France (FR), and Netherland (NL)	Ecoinvent unit processes
Plastic production (used to model avoided products)	PE Polyethylene, HDPE, granulate, at plant/RER U ; Polyethylene, LDPE, granulate, at plant/RER U ; Polyethylene, LLDPE, granulate, at plant/RER U ; PS Polystyrene, expandable, at plant/RER U ; PVC Polyvinylchloride, at regional storage/RER U ; PET Polyethylene terephthalate, granulate, amorphous, at plant/RER U ; Polyethylene terephthalate, granulate, bottle grade, at plant/RER U ; PP Polypropylene, granulate, at plant/RER U ; Other Mean value of the data above	Ecoinvent unit processes

Supplementary Table 9. Comparison among environmental impacts of changes in waste flows and treatment structure in different scenarios.

Value Indicator	Scenario 2018	Exports Scenarios				Recycling rate Scenarios			Combination Scenarios	
		Zero exports	Half of exports	Half of exports of developed countries	Half of exports of developing countries	20% increase recycling rate	50% increase recycling rate	100% increase recycling rate	Half of exports +20% increase recycling rate	Half of exports +50% increase recycling rate
GW (kg CO ₂ eq)	1.34E+08	1.06E+09	5.97E+08	7.60E+08	-2.94E+07	1.49E+07	-6.03E+07	-4.57E+07	4.94E+08	5.42E+08
FPMF (kg PM _{2.5} eq)	-5.29E+06	-1.04E+07	-7.85E+06	-7.55E+06	-5.58E+06	-5.55E+06	-5.88E+06	-6.32E+06	-8.18E+06	-8.54E+06
FWE (kg 1,4-DCB eq)	-5.65E+07	-8.86E+07	-7.26E+07	-8.07E+07	-4.84E+07	-6.04E+07	-5.84E+07	-4.39E+07	-7.33E+07	-5.91E+07
HCT (kg 1,4-DCB eq)	-2.47E+07	-2.53E+07	-2.50E+07	-2.67E+07	-2.29E+07	-2.57E+07	-2.46E+07	-1.92E+07	-2.54E+07	-2.10E+07
WC (m ₃)	-3.29E+09	-5.76E+09	-4.53E+09	-4.53E+09	-3.29E+09	-2.97E+09	-2.59E+09	-1.99E+09	-4.22E+09	-3.90E+09
Eco-costs (Euro/year)	-2.35E+09	-4.05E+09	-3.20E+09	-3.17E+09	-2.37E+09	-2.16E+09	-1.93E+09	-1.54E+09	-3.02E+09	-2.82E+09

Values of 2018 scaled to 1:

GW	1	7.90	4.45	5.67	-0.22	0.11	-0.45	-0.34	3.68	4.04
FPMF	-1	-1.97	-1.48	-1.43	-1.06	-1.05	-1.11	-1.19	-1.55	-1.61
FWE	-1	-1.57	-1.28	-1.43	-0.86	-1.07	-1.03	-0.78	-1.30	-1.05
HCT	-1	-1.03	-1.01	-1.08	-0.93	-1.04	-1.00	-0.78	-1.03	-0.85
WC	-1	-1.75	-1.38	-1.38	-1.00	-0.90	-0.79	-0.61	-1.28	-1.19
Eco-costs	-1	-1.73	-1.36	-1.35	-1.01	-0.92	-0.82	-0.66	-1.29	-1.20

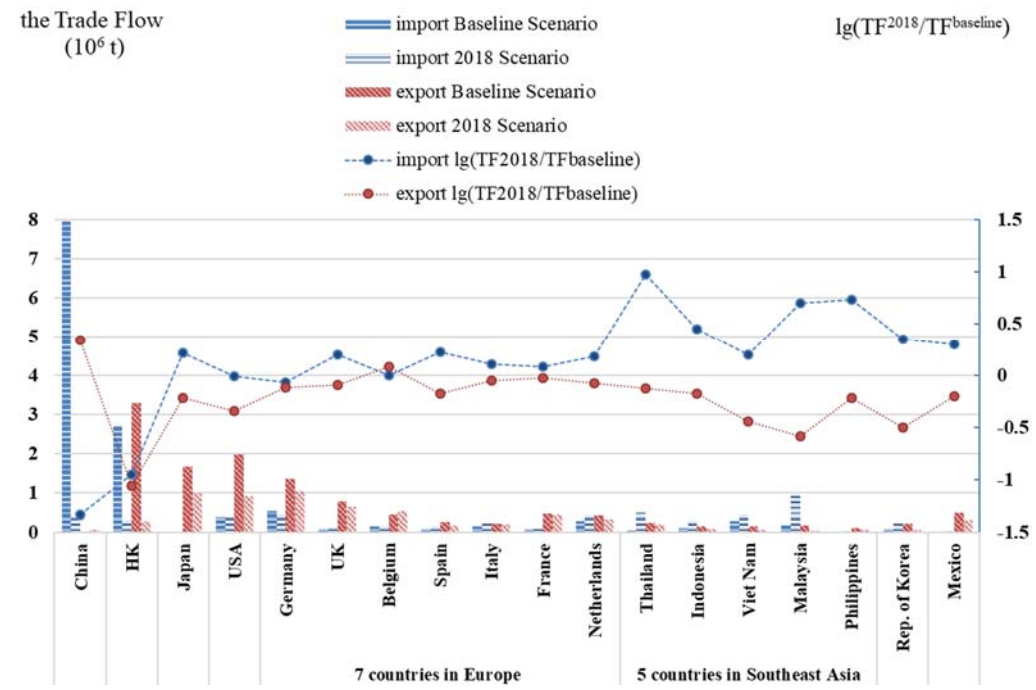
Supplementary Table 10. The trade flows of global plastic waste market from Comtrade in 2019 Scenario (Unit: t). *Data with the orange background were estimated on the basis of mirror data and blank table indicate missing data.

<i>Exporter</i> <i>Importer</i>	China	HK	Japan	USA	Europe 7						Southeast Asia 5					Rep. of Korea	Mexico
					Germany	UK	Belgium	Spain	Italy	France	Netherlands	Thailand	Indonesia	Viet Nam	Malaysia		
China	-	271.45	19202.23	16910.39	2632.46	9413.02	2669.71		5910.63							1853.62	
HK		-	57348.57	72743.29	93110.15	62231.39	39360.66		808.12							702.53	
Japan		71.74	-	585.37	278.31	44.33										398.65	
USA		43.79	15727.87	-	14377.44	1022.80	3422.62		1623.67							378.41	
Europe 7	Germany		141.42	2639.76	1137.18	-	31764.61	28042.34	18561.86							2.00	
	UK		2.68	68.52	816.68	33162.28	-	4188.88	122.24								
	Belgium		46.63	358.55	2297.52	26367.45	19509.02	-	718.62								
	Spain		0.00	2385.16	4397.18	5139.39	28967.13	1283.21	-	8005.43						0.00	
	Italy			168.66	510.91	17784.37	12614.03	7901.47		-						2.98	
	France		0.00	143.57	142.70	20055.86	22105.80	42605.79		8605.05	-					0.00	
Southeast Asia 5	Netherlands		0.00	490.93	246.79	142980.36	54251.69	97427.62		587.35		-				0.00	
	Thailand		91625.38	102332.80	27218.89	1550.30	1194.41	128.74	373.51			-				3115.51	
	Indonesia		1365.52	16929.25	24338.91	34337.97	22537.93	14817.02	24.71				-			701.42	
	Viet Nam		80438.07	116616.64	21620.17	14892.05	152.82	16252.57	526.83					-		13546.90	
	Malaysia		51127.54	261743.04	60625.26	182486.96	0.00	62533.05	11542.51						-	8857.19	
	Philippines		1627.76	13907.65	7888.33	339.19	0.00	22.96	0.00						-	517.12	
Rep. of Korea		498.73	88878.90	30980.46	6932.30	4450.72	6107.97		46.07							-	
Mexico		0.00	0.00	36943.18	668.44	0.00	439.68		1279.82							0.00	

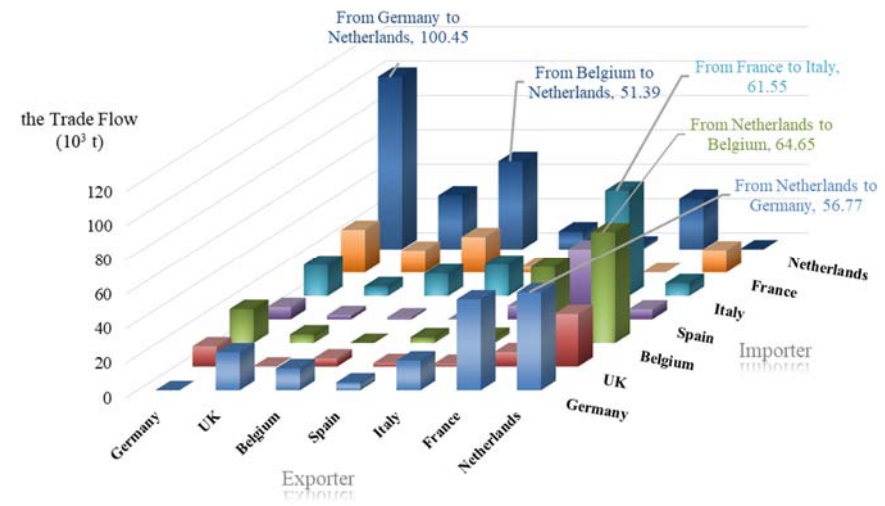
Supplementary Table 11. The trade flows of global plastic waste market from Comtrade in 2017 Scenario (Unit: t).

<i>Importer</i> \ <i>Exporter</i>	China	HK	Japan	USA	Europe 7							Southeast Asia 5					Rep. of Korea	Mexico	
					Germany	UK	Belgium	Spain	Italy	France	Netherlands	Thailand	Indonesia	Viet Nam	Malaysia	Philippines			
China	-	1710971.30	749380.74	557875.21	345836.66	164174.98	113768.77	115911.32	40115.32	77750.26	69736.50	333515.11	173938.16	265923.12	115844.79	55826.87	119574.90	95952.68	
HK	297.61	-	274759.41	373147.81	99193.96	77543.60	31566.27	46982.88	2081.25	36971.76	18918.54	41311.27	5431.13	5237.53	14838.75	4541.55	7028.83	55338.94	
Japan	491.19	165.70	-	1260.55	32.45	21.70	378.05	159.43	0.00	0.04	2.87	344.68	2.90	2232.21	38.20	947.08	921.00	2.94	
USA	10073.82	148.97	3523.87	-	16109.13	920.38	6190.06	300.82	6436.50	1631.93	291.36	2388.78	2731.83	4.71	567.01	0.01	233.46	190040.84	
Europe 7	Germany	168.57	0.00	14.62	1043.22	-	23256.09	30690.85	9399.43	28798.71	35090.53	76820.36	0.64	0.02	0.00	20.46	0.00	0.00	59.30
	UK	1254.35	0.00	65.70	339.61	24373.77	-	4233.22	1217.28	3296.77	6810.53	59056.86	0.00	10.16	4.90	0.00	0.00	0.00	364.12
	Belgium	54.40	23.74	45.05	1254.25	21017.35	8786.10	-	1222.33	1687.07	28001.62	47440.94	0.00	140.00	0.00	0.00	0.00	0.00	157.15
	Spain	23.80	0.00	1106.62	8593.95	8003.49	1967.38	1772.73	-	13583.31	66445.41	2650.57	0.00	0.00	0.00	25.94	0.00	0.00	65.89
	Italy	26.65	0.00	40.00	15.37	20707.45	6036.46	11534.47	27518.18	-	79222.28	11059.11	0.00	360.00	0.00	0.00	0.00	0.00	92.38
	France	0.00	0.00	0.00	59.01	22556.00	14125.24	34068.43	9514.41	7342.75	-	11353.74	0.00	0.39	3.82	0.00	0.00	0.00	80.65
	Netherlands	164.61	0.00	0.00	1570.67	141680.89	45146.57	97022.05	3093.74	1941.17	38013.87	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Southeast Asia 5	Thailand	2467.13	10919.68	58160.48	32862.36	2702.27	2420.70	3462.11	4187.33	417.06	270.90	290.49	-	590.45	429.75	6813.29	214.14	604.24	386.95
	Indonesia	722.80	474.01	2699.51	29174.87	564.62	38592.05	4935.94	790.49	0.00	439.91	1387.40	16.87	-	58.67	1986.25	68.94	401.52	3402.77
	Viet Nam	294.73	21595.30	126219.22	137193.47	69242.47	54312.66	44336.58	23601.20	5959.17	6200.51	9291.73	18951.28	1183.68	-	1316.39	104.60	50787.06	2548.31
	Malaysia	2166.88	32885.50	75435.09	121139.66	75242.09	91468.71	18051.47	22213.22	4369.80	15455.43	2948.30	534.39	2192.18	157.01	-	1028.92	12984.90	5233.71
	Philippines	0.00	4895.09	2138.91	3635.06	176.00	1418.58	76.98	195.36	0.00	0.00	0.96	236.83	147.42	46.10	41.96	-	4397.46	283.09
Rep. of Korea	91.82	760.55	33258.10	9139.37	842.63	4593.84	2964.16	266.56	39.64	115.55	1048.54	107.41	1583.94	17737.25	300.38	2428.00	-	655.18	
Mexico	134.73	0.00	0.00	47175.43	1333.57	0.00	862.57	244.37	293.64	27.74	1.36	0.00	0.00	0.00	0.00	0.00	0.00	6.22	-

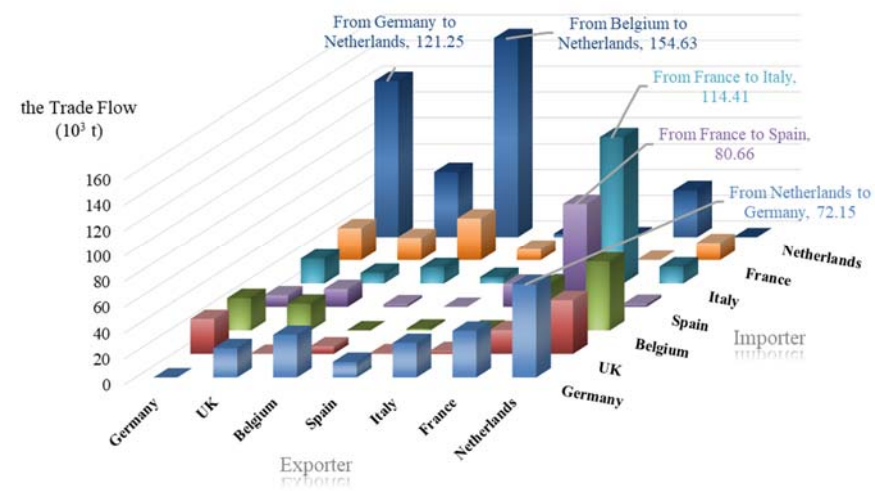
Figure



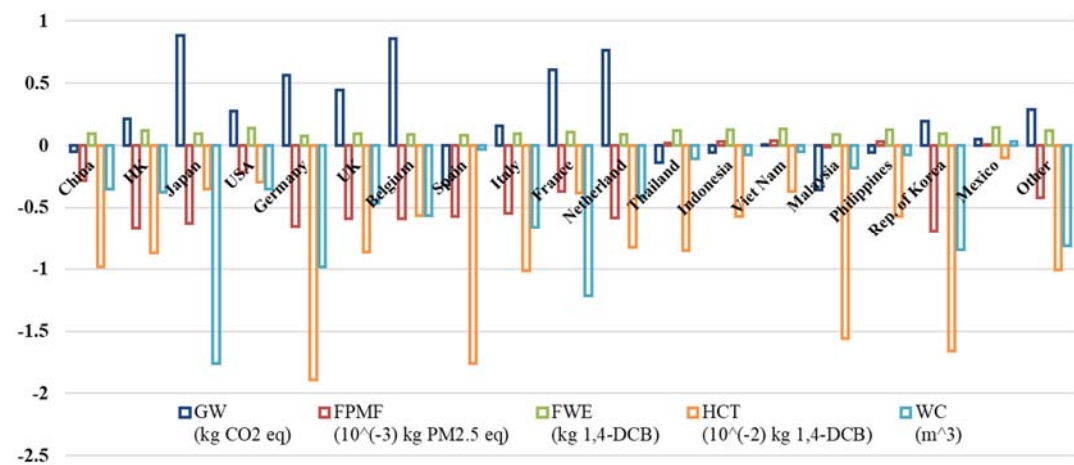
Supplementary Figure 1. The changes of import and export flows after the ban.



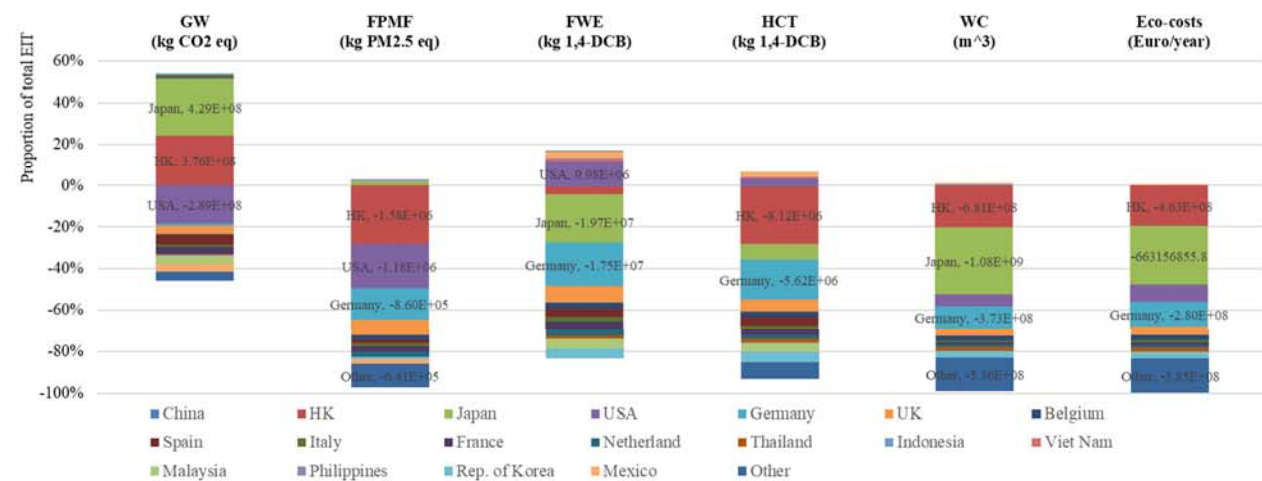
Supplementary Figure 2. The trade flows among Europe 7 members in Baseline Scenario.



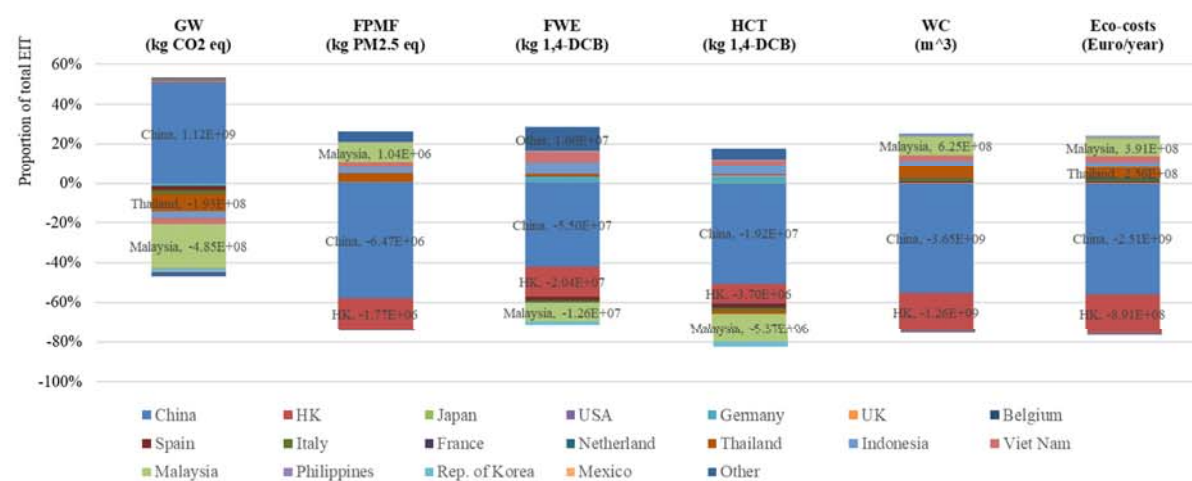
Supplementary Figure 3. The trade flows among Europe 7 members in 2018 Scenario.



Supplementary Figure 4. The EIT of treating 1 kg of plastic waste in domestic management in 2018.

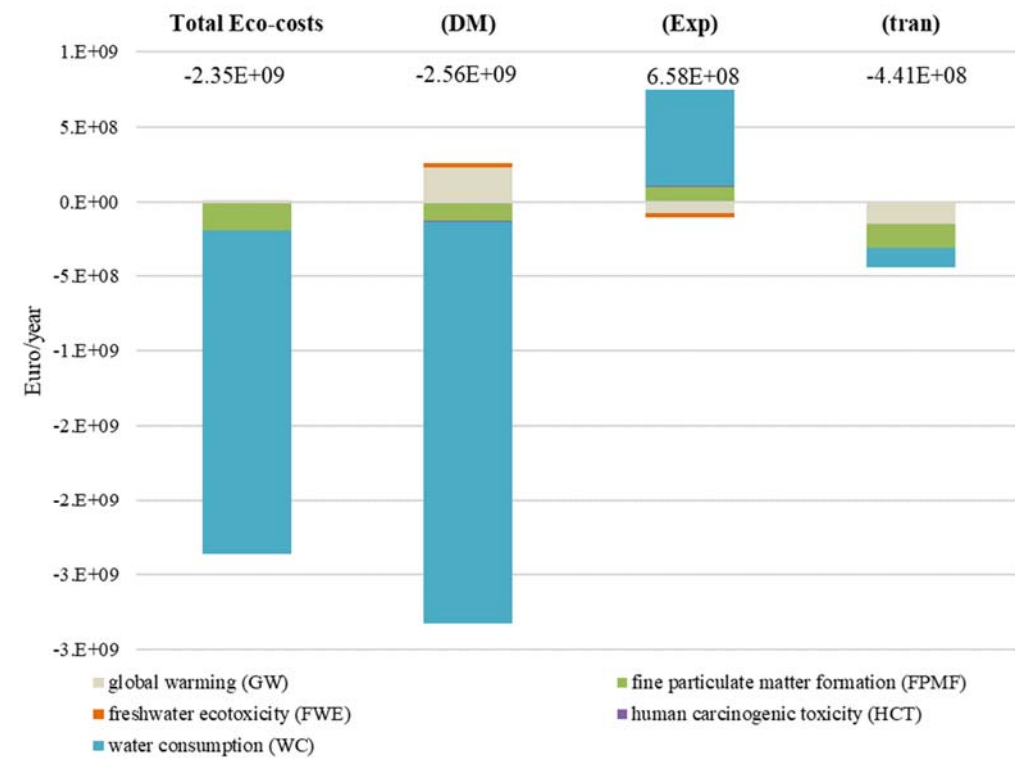


(a) Export countries



(b) Import countries

Supplementary Figure 5. Contribution of changes of export and import countries to total EIT in 2018 Scenario.



Supplementary Figure 6. Contributions of Eco-costs in 2018 Scenario of each midpoint category.

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