

Supplemental material

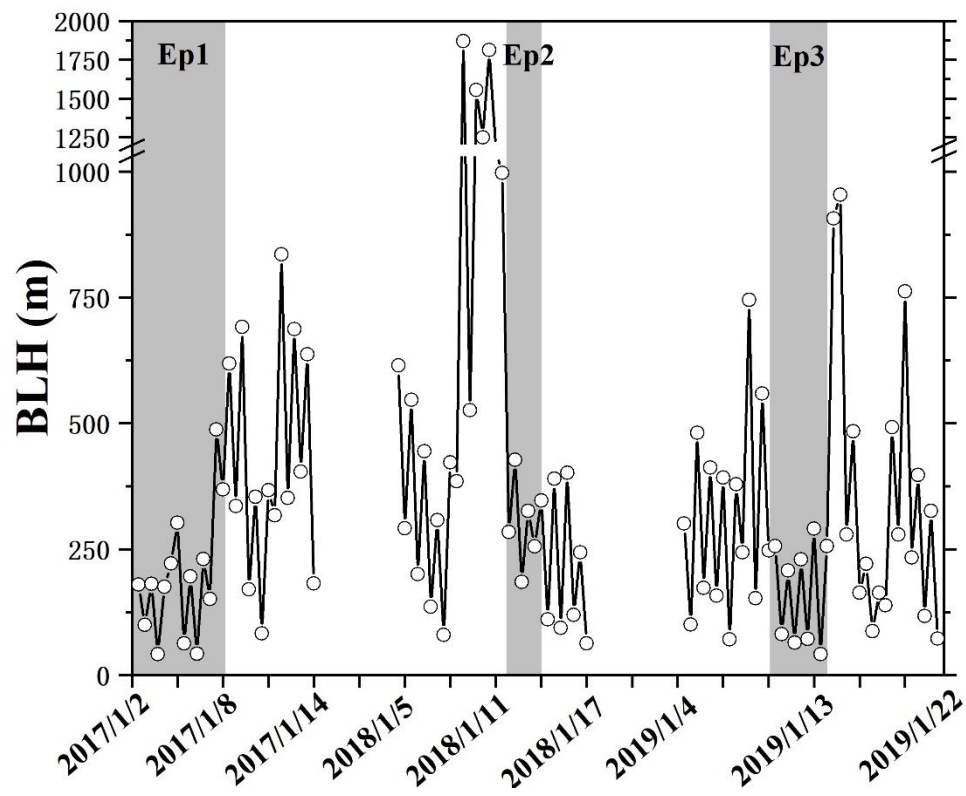


Figure. S1. Time series of BLH during January 2017, 2018 and 2019.

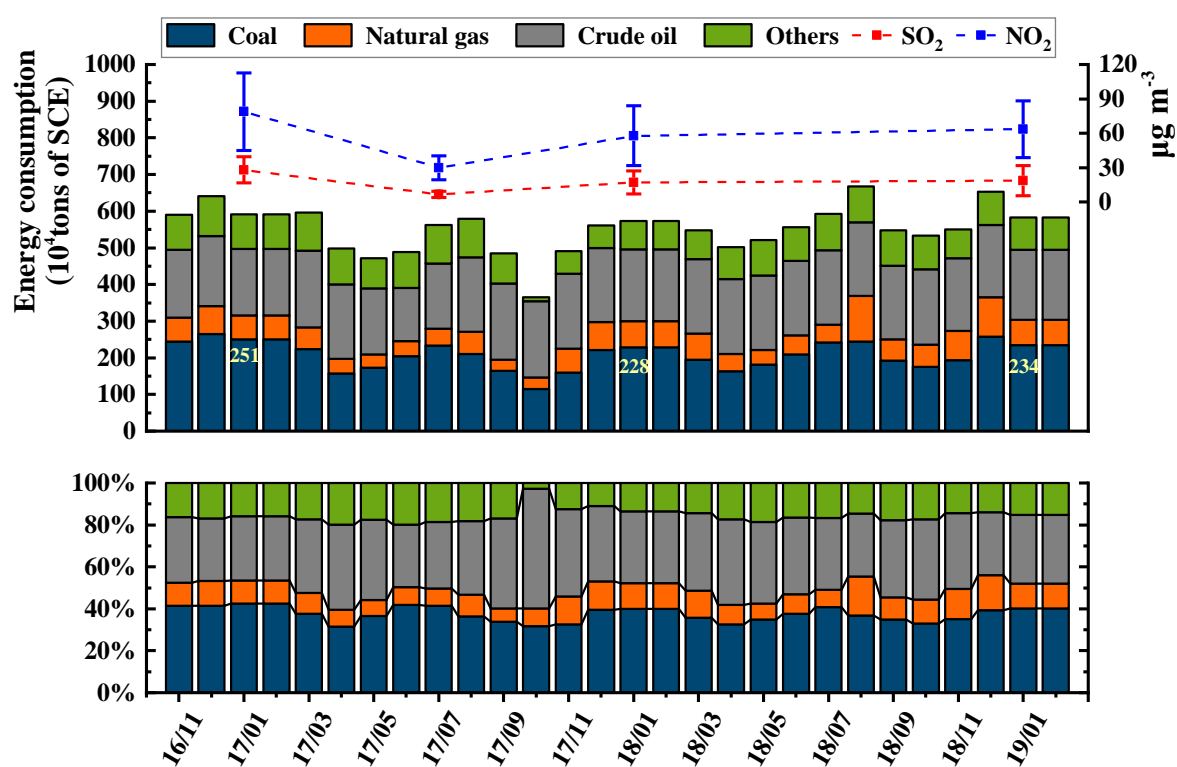


Figure. S2. Consumption of electricity and industrial energy above scale, including coal, natural gas, crude oil, and others (coke, oil product, and thermal) in Tianjin from Jan-2016 to Jan-2019. Data from Tianjin Municipal People's Government. Values for January and February each year are average consumption estimated by the sum of them. The SO₂ and NO₂ data during the sampling period come from the Air Quality Monitoring Station.

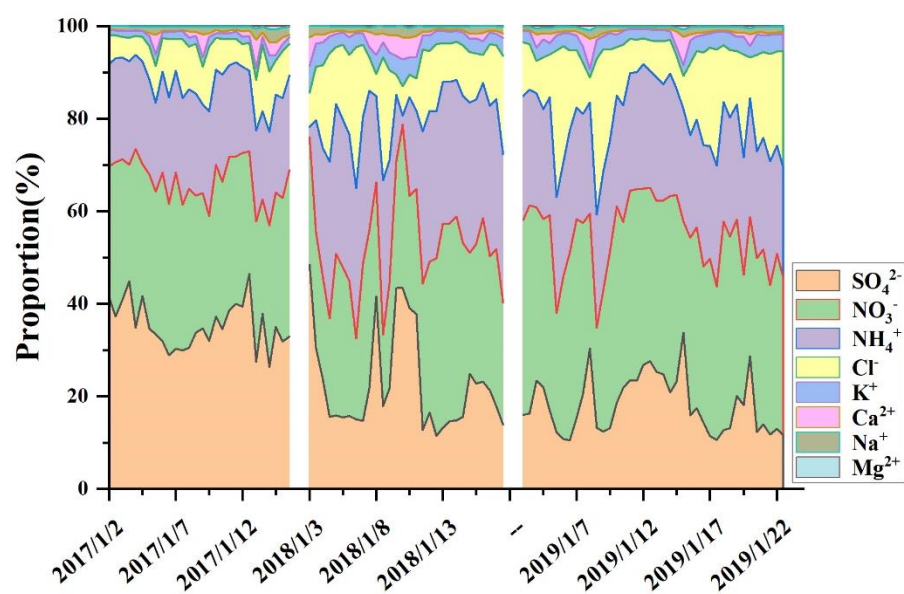


Figure. S3. Proportion of water-soluble ions in PM_{2.5} during sampling period.

Table.S1. Features of sampling phases

Abbreviation	Period	Season	CRP
Jan-2017	1/2~1/15/2017	winter	before
Jan-2018	1/3~1/17/2018	winter	1 year later
Jan-2019	1/3~1/22/2019	winter	2 years later

Table S2. The concentration of PM_{2.5}, SO₂, SO₄²⁻ (μg/m³), and δ³⁴S_{sulfate} values of air mass from different clusters.

	Cluster	PM _{2.5}	SO ₂	SO ₄ ²⁻	δ ³⁴ S _{sulfate}
2017/01	1	157.4	29.7	24.9	4.9
	2	215.9	32.5	42.5	5.2
	3	146.5	33.0	19.8	7.4
	4	55.5	12.8	4.1	4.7
	5	73.5	21.5	4.9	6.3
2018/01	1	30.5	12.6	2.7	6.1
	2	77.7	21.8	6.5	5.3
	3	23.7	6.7	1.7	6.1
	4	125.9	26.0	9.9	5.2
2019/01	1	72.2	22.1	5.8	4.7
	2	43.5	14.9	2.8	4.8
	3	114.2	22.9	12.7	3.2
	4	18.8	8.4	1.3	6.1

Table S3. The contribution and uncertainties of different oxidation pathway

	Ep1		Ep2		Ep3	
	f _i (%)	std	f _i (%)	std	f _i (%)	std
OH	25.9	0.2	5.3	0.05	18.0	0.1
H ₂ O ₂ /O ₃	21.2	0.1	4.2	0.04	17.2	0.1
TMI	24.7	0.1	72.6	0.1	32.3	0.1
NO ₂	28.2	0.2	17.9	0.1	32.5	0.2