China Integrated Waste Management NAMA

Monitoring and Evaluation Report on Greenhouse Gas Emission Reductions in MSW management of the Demonstration Municipalities of China IWM NSP

(4th monitoring period)

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Report management
Dr. Liu Xiao

Authors:
Sino Carbon Innovation & Investment Co., Ltd.
China Municipalities Construction Design and Research Institute Co., Ltd.
China Environmental Resources Technology Co., Ltd.

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On behalf of
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
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Monitoring period No.	04					
Monitoring period	01/11/2020-30/04/2021					
Demonstration Municipalities	Suzhou	Xi'an	Tai'an	Lanzhou	Bengbu	Total
Emission reductions generated during the monitoring period （tCO_2e）	148729	859377	56462	8201	170458	1243227
Guidance documents on the assessment of emission reductions	*Greenhouse Gas Emission Reductions • MRV Model of Municipal Solid Waste Management* *Baseline Study Report on Greenhouse Gas Emissions of Demonstration Municipalities* *Greenhouse Gas Emission Reductions Monitoring and Evaluation Plan of Demonstration Municipalities*					

Emission reduction assessment conclusion:

(1) Compliance of monitoring implementation with monitoring plan

Through on-site investigation and review of supporting documents, the project team confirmed that the greenhouse gas emission reduction monitoring activities of the demonstration municipalities are basically consistent with the monitoring requirements of "Greenhouse Gas Emission Reductions MRV Model of Municipal Solid Waste Management" (hereinafter "MRV model") and "Greenhouse Gas Emission Reductions Monitoring and Evaluation Plan of Demonstration Municipalities" (hereinafter "monitoring plan"), but the monitoring of waste composition and waste recovery rate in some municipalities is not implemented in accordance with the monitoring plan. More details are demonstrated in Section 4.5.

(2) Calculation and comparison analysis of emission reductions

The total emission reductions generated by the demonstration municipalities during the fourth monitoring period (01/11/2020-30/04/2021) are 1,243,227 tCO2e, which is 28.37% lower than the estimated emission reductions in the "Baseline Study Report on Greenhouse Gas Emissions of Demonstration Municipalities" (hereinafter "baseline study report"). The main reason for the decline is that there exist differences between the actual monitored data and the design value applied in the baseline study report. The specific reasons for each city and the comparative analysis of the emission intensity per ton of waste treatment are described in detail in Sections 4.2~4.4.

(3) Summary of emission reductions

The total emission reductions of the demonstration municipalities during all the monitoring periods (1st monitoring period ~ 4th monitoring period) are 3,843,245 tCO2e. Comparison of emission reductions for each city is in Section 4.1.

Monitoring period No.	Monitoring period	Suzhou	Xi'an	Tai'an	Lanzhou	Bengbu	Total
01	01/01/2019-30/04/2019	487	21622	22177	/	192614	**236900**
02	01/05/2019-31/10/2019	30918	37853	36837	1109	137396	**244113**
03	01/11/2019-31/10/2020	330596	1440947	89316	2945	255201	**2119005**
04	01/11/2020-30/04/2021	148729	859377	56462	8201	170458	**1243227**
Total		**510730**	**2359799**	**204792**	**12255**	**755669**	**3843245**

(4) Problems and suggestions in the evaluation process

Through monitoring and evaluation, the project team found that the demonstration municipalities have shortcomings in waste composition monitoring, data collection in the recycling process, and research on default values in respect to low-carbon waste management, etc. However, accompanying with the country's carbon peak and neutralization goals are proposed, accurate data accounting has important reference value obviously, whether to calculate the carbon emissions or the carbon emission reductions generated by the MSW treatment industry. Therefore, the project team made specific recommendations in Section 4.5.

Project team	Zhou Hongming, Wang Yuan, Chen Jie, Wang Lan, Liu Yixin, Zhang Bide, Chen Bing, Zhang Li, Zhong Lu, Fu Kai, Zhang Simeng, Chen Wensi, Pang Shanshan
Technical review by	Jin Yaning
Approved by	Tang Jin

Content

1 Overview of boundaries and emission reduction projects

1.1 Project boundary

The geographical boundary includes all areas (e.g. main urban area, suburban counties) that are covered by the whole waste management process. Project boundary includes the physical boundary which involves municipal solid waste (MSW) generation, collection and transportation, treatment/disposal and recycling. Emission sources include emissions generated and/or avoided by waste collection and transportation, treatment/disposal and recycling. The greenhouse gases include CO_2, CH_4, and N_2O.

In the monitoring period, no emission reductions from waste collection and transportation, and waste recycling were considered due to the following reasons: (1) the demonstration municipalities did not implement emission reduction measures of replacing gasoline and diesel vehicles with electric vehicles or biodiesel vehicles; (2) the data collection system on waste recycling remained imperfect; (3) the data collection boundary was changed, etc..

The project boundary of each municipality involved in the emission reduction projects during the monitoring period are as follows:

Table 1-1 The project boundaries of each municipality and the waste management processes involved in the emission reduction projects during the monitoring period

Demonstration municipalities	Geographical boundaries	The waste management processes involved in the emission reduction projects
Suzhou	Five districts: Gusu, Gaoxin, Wuzhong, Xiangcheng and Suzhou Industrial Park	☐ Collection and transportation ☑ Treatment/disposal ☐ Recycling
Xi'an	Seven districts: Xincheng, Beilin, Lianhu, Yanta, Baqiao, Weiyang and Chang'an	☐ Collection and transportation ☑ Treatment/disposal ☐ Recycling
Tai'an	Two districts: Taishan and Daiyue (including Taian Gaoxin Industrial Development District, excluding Mount Tai Scenic Spot)	☐ Collection and transportation ☑ Treatment/disposal ☐ Recycling
Lanzhou	Four districts: Chengguang, Qilihe, Anning, Xigu	☐ Collection and transportation ☑ Treatment/disposal ☐ Recycling
Bengbu	Four districts: Bengshan, Yuhui, Huaishang, Longzihu	☐ Collection and transportation ☑ Treatment/disposal ☐ Recycling

1.2 Description of emission reduction projects

The waste management projects officially put into operation after 01/01/2018 in the demonstration municipalities are defined as emission reduction projects for monitoring and evaluation. From 31/05/2021 to 16/06/2021, the project team conducted the fourth monitoring and evaluation in the five demonstration municipalities. Through on-site investigation and review of supporting documents, the project team confirmed that the information on the emission reduction projects implemented by each municipality during the monitoring period is as follows:

Table 1-2 Basic information on the demonstration municipalities' emission reduction projects during the monitoring period

Demonstration municipalities	Project title	Scale	Operation time
Suzhou	Newly built Agricultural Market Waste Treatment Station[1]	57 t/d	They were put into production one by one after January 2018.
	Qizishan Landfill Power Generation Plant	6MW	August 1, 2019
	Newly built Industrial Park Restaurant Waste Treatment Plant	300t/d	May 2019
	Newly built High-tech Zone Restaurant Waste Treatment Plant	200t/d of restaurant waste + 20t/d waste oil	December 2018 Trial operation
	Everbright Environment Energy (Suzhou) Co., Ltd. – expansion of MSW incineration power plant	2250t/d	November 2019
Xi'an	Newly built Restaurant Treatment Plant (Phase I)	200t/d of restaurant waste + 20t/d of waste oil	End of December 2018
	Xi'an Jingwei Kangheng Environmental Energy Co., Ltd.-Newly built MSW incineration power plant in Gaoling District	2250t/d	October 2019 Trial operation
	China Energy Conservation and Environmental Protection Group (Xi'an) - Newly built MSW incineration power plant in Huyi District	2250t/d	December 2019 Trial operation
	Everbright Environmental Energy (Lantian) Co., Ltd.- Newly built MSW incineration power plant in Lantian County	2250t/d	November 2019 Trial operation
	Beijing Enterprises Environmental Protection Technology Development Co., Ltd. - Newly built MSW Incineration Power Plant in Xixian District	3000t/d	November 2019 Trial operation
Tai'an	Tai'an Beikong Environmental Energy Developm ent Co., Ltd. – Newly built MSW incineration power plant (Grate Furnace)	1200t/d	End of November 2018

1 With the high-tech zones and industrial parks restaurant waste treatment plant put into operation one after another, eight agricultural market waste treatment station has been shut down. A total of 18 farmer's agricultural market waste treatment stations have been put into operation during the fourth monitoring period, with a total designed treatment capacity of 57t/d. The updated detailed list is shown in the Appendix 1.

Lanzhou	Anning District Organic Waste Treatment Station	20t/d organic waste	April 2019
	Anning District Bulky Waste Treatment Station	50t/d Bulky waste	June 2020
Bengbu	Bengbu Green Power Renewable Energy Co., Ltd. – Newly built MSW incineration power plant (Grate Furnace) Phase I	1210t/d	End of 2017[2]
	Bengbu Wangneng technology Co.,Ltd.-Newly-built restaurant treatment plant (Phase I)	100t/d	June 2020 Trial operation

2 It was put into operation at the end of 2017, but the operation period in 2017 was quite short, so the project team considered it as an emission reduction project.

2 Project monitoring

2.1 Suzhou

From 31/05/2021 to 01/06/2021, the project team conducted the fourth monitoring and evaluation in Suzhou. Through on-site investigation and review of the Production Report, Biogas Monthly Report, Leachate treatment report, Flare Operation Record and other supporting documents, the project team confirmed that the data and parameters monitored are as follows:

Table 2-1 Monitoring information of newly built Agricultural Market Waste Treatment Station in Suzhou3

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{COMP,y}$	Quantity of waste composted	t	3470.033	Weighbridge	Real-time
$EC_{COMP,y}$	Electricity consumption	MWh	439.243	Electricity meter	Continuous
$P_{OFS,y}$	Organic fertilizers production	t	704.804	Weighbridge	Real-time
Remark: 1) When calculating CO_2 emission reductions from organic fertilizer instead of chemical fertilizer, it is assumed that the chemical fertilizer efficiency is 2.8 times higher than that of organic fertilizer.					

Table 2-2 Monitoring information of Qizishan Landfill Power Generation Plant

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$ES_{LF,y}$	The amount of electricity fed into the grid	MWh	12775.14	Electricity meter	Continuous
$VL_{FG\_FL,LF,y}$	Volumetric flow of the landfill gas sent to the power generation system	m^3	8651876	Flow meter	Continuous
$FL_{FG,LF,y}$	Fraction of methane in landfill gas	/	29.17%	Biogas analyzer	Continuous

3 The default values applied in Suzhou and other four demonstration municipalities are provided in Appendix 2.

Table 2-3 Monitoring information of newly built Industrial Park Restaurant Waste Treatment Plant

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{wt,AD,y}$	The amount of waste treatment in anaerobic digesters	t	73644.07	Weighbridge	Real-time
$V_{BGS,AD,y}$	The amount of biogas collected at the digester outlet	Nm^3	6499723	Flow meter	Continuous
$V_{CH4\_BL,AD,y}$	The amount of biogas purification	Nm^3	2876796	Flow meter	Continuous
$V_{CH4\_FL,AD,y}$	Volumetric flow of the biogas sent to the flare	Nm^3	1856889	Flow meter	Continuous
$EC_{AD,y}$	Electricity consumption	MWh	5459.403	Electricity meter	Continuous
$BDS_{PJ,y}$	Grease production	t	2202.16	Weighbridge	Real-time
$HC_{AD,y}$	Heat consumption	GJ	5007.52	Flow meter	Continuous
Remark: 1) When calculating CO_2 emission reductions from biodiesel instead of diesel, the biodiesel output is converted as 90% of the grease production.					

Table 2-4 Monitoring information of newly built High-tech Zone Restaurant Waste Treatment Plant

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{wt,AD,y}$	The amount of waste treatment in anaerobic digesters	t	56415.3	Weighbridge	Real-time
$V_{BGS,AD,y}$	The amount of biogas collected at the digester outlet	Nm^3	2746179	Flow meter	Continuous
$V_{CH4\_FL,AD,y}$	Volumetric flow of the biogas sent to the flare	Nm^3	1812761	Flow meter	Continuous
$EC_{AD,y}$	Electricity consumption	MWh	2299.897	Electricity meter	Continuous
$DBS_{PJ,y}$	Grease production	t	2267.28	Weighbridge	Real-time
Remark: 1) When calculating CO_2 emission reductions from biodiesel instead of diesel, the biodiesel output is converted as 90% of the grease production.					

Table 2-5 Monitoring information of expansion of Everbright Environment Energy MSW Incineration Power Plant

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{INC,y}$	The amount of waste treated by incineration plant	t	390999	Weighbridge	Real-time
$P_{j,y}$	Proportion of waste composition j	/	Food waste: 39.13% (Moisture content 78.77%) Rubber: 0% Plastic: 40.17% (Moisture content 38.45%) Textile: 6.29% (Moisture content 40.05%) Others (excluding paper and wood): 0.76% (Moisture content 10.7%) Metal: 0.43% (Moisture content 5.12%) Glass: 0.96% (Moisture content 6.11%)	/	Once a month
$EC_{INC,y}$	Electricity consumption	MWh	1962.048	Electricity meter	Continuous
$ES_{INC,y}$	The amount of electricity to the grid	MWh	194443.356	Electricity meter	Continuous
$HS_{INC,y}$	The amount of heat supplied to users	GJ	/	Flow meter	Continuous
$FC_{i,BINC,x}$	Biogas consumption	Nm^3	88440	Flow meter	Continuous

Through on-site investigation, review of supporting documents, the project team confirmed that the accuracy, calibration standards, frequency and other information of the monitoring equipment for all parameters are consistent with the monitoring plan.

2.2 Xi'an

From 09/06/2021 to 11/06/2021 the project team conducted the fourth monitoring and evaluation in Xi'an. Through on-site investigation and review of the supporting documents such as Production Report, Flare Operation Record and other documents. The data and parameters monitored are as follows:

Table 2-6 Monitoring information of Xi'an Restaurant Waste Treatment Plant (Phase I)

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{wt,AD,y}$	The amount of waste treatment in anaerobic digesters	t	38163.95	Electronic truck scale	Real-time
$V_{BGS,AD,y}$	The amount of biogas collected at the digester outlet	Nm^3	2588738.22	Flow meter	Continuous
$V_{CH4\_BL,AD,y}$	Volumetric flow of biogas used for heat generation in boiler	Nm^3	1034272.14	Flow meter	Continuous
$V_{CH4\_PG,AD,y}$	Volumetric flow of biogas used for generator	Nm^3	1147873.95	Flow meter	Continuous
$V_{CH4\_FL,AD,y}$	Volumetric flow of the biogas sent to the flare	Nm^3	406592.12	/	/
$F_{CH4,AD,y}$	Fraction of methane in biogas	/	49.83%	Biogas analyzer	Continuous
$EC_{AD,y}$	Electricity consumption	MWh	1447.59	Electricity meter	Continuous
$ES_{AD.\ y}$	The amount of electricity to the grid	MWh	336.05	Electricity meter	Continuous
$BDS_{PJ,y}$	Grease production	t	3365.59	Weighbridge	Real-time

Remarks:

1) The project boundaries of Xi'an cover seven districts, namely Xincheng, Beilin, Lianhu, Yanta, Yanqiaot, Weiyang and Chang'an. The waste treated by the restaurant waste treatment plant is partially sourced from Xixian New District, therefore the project team calculated emission reductions by deducting the waste from Xixian New District from the total amount of waste treatment in the restaurant waste treatment plant. The other parameters were calculated according to the proportion of waste treatment within the project boundary in the total waste treatment.

2) The amount of the biogas sent to the flare of Xi'an restaurant waste treatment plant is a calculated value, which equals to the total amount of biogas collection minus the amount of biogas sent to the boiler and generator.

3) When calculating CO_2 emission reductions from biodiesel instead of diesel, the biodiesel output is converted as 90% of the grease production.

Table 2-7 Monitoring information of the newly built MSW Incineration Power Plant in Gaoling District

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{INC,y}$	The amount of waste treatment by incineration	t	296193.274	Weighbridge	Real-time
$P_{j,y}$	Proportion of waste composition j4	/	Textile:7.71% (Moisture content 40.05%) Food waste: 29.04% (Moisture content 78.77%) Rubber and leather: 2.61% (Moisture content 0) Plastic: 28.62% (Moisture content 38.45%) Metal: 2.54% (Moisture content 5.12%) Glass: 4.75% (Moisture content 6.11%) Others (excluding paper and wood): 8.26% (Moisture content 10.70%)	/	/
$EC_{INC,y}$	Electricity consumption	MWh	/	Electricity meter	Continuous
$FC_{i,INC,y}$	Biogas consumption	m^3	236254	Flow meter	Continuous
$ES_{INC,y}$	The amount of electricity to the grid	MWh	139906.126	Electricity meter	Continuous
$HS_{INC,y}$	The amount of heat to the grid	GJ	15182.55	Flow meter	Continuous
$W_{INC,y}$	The amount of wastewater treated by anaerobic section	m^3	52065.402	Flow meter	Continuous
$COD_{in,INC,y}$	The COD concentration of wastewater at the inlet of anaerobic treatment system	kgCOD /m^3	42.5885	COD detector	Daily
$COD_{out,INC,y}$	The COD concentration of wastewater at the outlet of anaerobic treatment system	kgCOD /m^3	3.059	COD detector	Daily
$R_{ww,INC,y}$	Methane recovery	$kgCH_4$	333371.4087	Flow meter	Continuous
$V_{BGS\_FL,INC,y}$	The amount of biogas sent to the flare	Nm^3	/	Flow meter	Continuous

4 At present, only Suzhou has carried out the monitoring of the moisture content of the waste components. Considering that the moisture content of the waste components in each city will not be very different, the four demonstration cities of Xi'an, Tai'an, Lanzhou and Bengbu during the monitoring period adopts the data monitored by Suzhou.

Remark:
1) Since the waste treatment boundary of the newly built domestic waste incineration power plant in Gaoling District exceeds the project boundary, the monthly domestic waste incineration volume of the city under the project activity = the monthly total waste input from the incineration plant per month * the monthly total waste entering the plant within the NAMA boundary Quantity/Monthly total amount of waste coming into the incineration plant. The natural gas consumption of the incineration plant, the purchased electricity, the amount of power delivered to the grid, the amount of heat delivered to the thermal users, the amount of wastewater treated in the anaerobic section, and the amount of methane recovered are calculated using the same method. In addition, the company was unable to provide data on the volume of waste collected and transported by the districts during the monitoring period and explained that the collection and transportation scope has not changed compared with the previous monitoring period. Therefore, the split ratio in this monitoring period adopts the average value of the previous monitoring period.
2) During the monitoring period, Xi'an did not carry out the monitoring of waste components. According to the research results of the three monitoring periods, the waste components are very important for the calculation results of emission reductions. Moreover, with the continuous improvement of the economic level, the waste composition data obtained by Xi'an in 2018 can no longer reflect the current actual situation. At present, only Suzhou and Bengbu of the five demonstration cities have carried out the monitoring of waste components according to the requirements. Considering that Xi'an's economic development level is located between Suzhou and Bengbu, the waste composition of Xi'an during the monitoring period adopts the average value of Suzhou and Bengbu.
3) During the monitoring period, all the biogas produced by the anaerobic treatment of the leachate was sent to the boiler for combustion, but not sent to the flare.

Table 2-8 Monitoring information of the newly built MSW Incineration Power Plant in Huyi District

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{INC,y}$	The amount of waste treated by incineration plant	t	297246.32	Weighbridge	Real-time
$P_{j,y}$	Proportion of waste composition j	/	Textile:7.71% (Moisture content 40.05%) Food waste: 29.04% (Moisture content 78.77%) Rubber and leather: 2.61% (Moisture content 0) Plastic: 28.62% (Moisture content 38.45%) Metal: 2.54% (Moisture content 5.12%) Glass: 4.75% (Moisture content 6.11%) Others (excluding paper and wood): 8.26% (Moisture content 10.70%)	/	/
$FC_{i,INC,y}$	Natural gas consumption	m^3	516736	Flow meter	Continuous
$EC_{INC,y}$	Electricity consumption	MWh	0	Electricity meter	Continuous
$ES_{INC,y}$	The amount of electricity to the grid	MWh	123440.31	Electricity meter	Continuous

$V_{BGS\_FL,INC,y}$	The amount of biogas sent to the flare	Nm^3	1426818.458	Flow meter	Continuous
$F_{CH4,INC,y}$	Proportion of methane in biogas	/	55.7%	Biogas analyzer	Continuous
Remarks: 1) Since the boundary covered by the newly-built MSW incineration power plant in Huyi district exceeds the boundary of NAMA project, the data are processed in the same manner as that in Gaoling district (remark 1). 2) The details of the waste composition data refer to the incineration power plant in Gaoling District (remark 2).					

Table 2-9 Monitoring information of the newly-built MSW incineration power plant in Lantian County

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{INC,y}$	The amount of waste treated by incineration plant	t	336141.437	Weighbridge	Real-time
$P_{j,y}$	Proportion of waste composition j	/	Textile:7.71% (Moisture content 40.05%) Food waste: 29.04% (Moisture content 78.77%) Rubber and leather: 2.61% (Moisture content 0) Plastic: 28.62% (Moisture content 38.45%) Metal: 2.54% (Moisture content 5.12%) Glass: 4.75% (Moisture content 6.11%) Others (excluding paper and wood): 8.26% (Moisture content 10.70%)	/	/
$FC_{i,INC,y}$	Diesel consumption	t	61.431	Flow meter	Continuous
$EC_{INC,y}$	Electricity consumption	MWh	0	Electricity meter	Continuous
$ES_{INC,y}$	The amount of electricity to the grid	MWh	168210.591	Electricity meter	Continuous
$W_{INC,y}$	The amount of wastewater treated by anaerobic section	m^3	41066.594	Flow meter	Continuous
$COD_{in,INC,y}$	The COD concentration of wastewater at the inlet of anaerobic treatment system	kgCOD /m^3	38.232	COD detector	Daily
$COD_{out,INC,y}$	The COD concentration of wastewater at the outlet of anaerobic treatment system	kgCOD /m^3	1.771	COD detector	Daily
$R_{ww,INC,y}$	Methane recovery	$kgCH_4$	185380.0292	Flow meter	Continuous
$V_{BGS\_FL,INC,y}$	The amount of biogas sent to the flare	Nm^3	0	/	/

Remarks:
1) Since the boundary covered by the newly-built MSW incineration power plant in Lantian County exceeds the boundary of NAMA project, the data are processed in the same manner as that in Gaoling district (remark 1).
2) The details of the waste composition data refer to the incineration power plant in Gaoling District (remark 2).
3) The biogas produced by the anaerobic treatment of the leachate is basically sent to the boiler for combustion, and only when there is a failure, it is sent to the torch, and the amount sent to the torch is very small. Considering that the enterprise does not install a flow meter for measurement, the amount of biogas sent to the torch during this monitoring period is counted as zero.

Table 2-10 Monitoring information of the newly built MSW Incineration Power Plant in Xixian District

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{INC,y}$	The amount of waste treated by incineration plant	t	426827.6	Weighbridge	Real-time
$P_{j,y}$	Proportion of waste composition j	/	Textile:7.71% (Moisture content 40.05%) Food waste: 29.04% (Moisture content 78.77%) Rubber and leather: 2.61% (Moisture content 0) Plastic: 28.62% (Moisture content 38.45%) Metal: 2.54% (Moisture content 5.12%) Glass: 4.75% (Moisture content 6.11%) Others (excluding paper and wood): 8.26% (Moisture content 10.70%)	/	/
$FC_{i,INC,y}$	Diesel consumption	t	110.579	Flow meter	Continuous
$EC_{INC,y}$	Electricity consumption	MWh	5.04	Electricity meter	Continuous
$ES_{INC,y}$	The amount of electricity to the grid	MWh	185916.72	Electricity meter	Continuous
$V_{BGS\_FL,INC,y}$	The amount of biogas sent to the flare	Nm^3	601908	Flow meter	Continuous
$F_{CH4,INC,y}$	Proportion of methane in biogas	/	69.8%	Biogas analyzer	Continuous
Remarks: 1) Since the boundary covered by the newly built MSW Incineration Power Plant in Xixian District exceeds the boundary of NAMA project, the data are processed in the same manner as that in Gaoling district (remark 1). 2) The details of the waste composition data refer to the incineration power plant in Gaoling District (remark 2).					

Through on-site visits and inspection of supporting documents such as calibration reports, the project team confirmed that except for the waste components and the amount of torch biogas in the kitchen factory, and the accuracy, calibration standards, frequency and other information of the monitoring equipment of other parameters are consistent with the monitoring plan.

2.3 Tai'an

From 26/05/2021 to 27/05/2021, the project team conducted the fourth monitoring and evaluation in Tai'an. Through on-site investigation and review of the supporting documents such as Waste Volume Summary Table, Production and Operation Data Statistics Table, Record Table on Influent of Anaerobic Tank in the WasteWater Treatment Station and Water Quality Inspection Report etc., the project team confirmed data and parameters monitored are as follows:

Table 2-11 Monitoring information of Tai'an Incineration Power Plant (Grate Furnace)

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{INC,y}$	The amount of waste treated by incineration plant	t	202251.36	Weighbridge	Real-time
$P_{j,y}$	Proportion of waste composition j	/	Textile: 9.13% (Moisture content40.05%) Food waste: 18.94% (Moisture content78.77%) Rubber and leather: 5.21% (Moisture content0) Plastic: 17.07% (Moisture content38.45%) Metal: 4.65% (Moisture content5.12%) Glass:8.53% (Moisture content6.11%) Others (excluding paper and wood): 15.75% (Moisture content10.7%)	/	/
$FC_{i,INC,y}$	Diesel consumption	t	99.38	Weighbridge	Each purchase
$EC_{INC,y}$	Electricity consumption	MWh	3.29	Electricity meter	Continuous
$ES_{INC,y}$	The amount of electricity to the grid	MWh	64292.6	Electricity meter	Continuous
$HS_{INC,y}$	The amount of heat supplied to users	GJ	79792.95	Flow meter	Continuous
$W_{INC,y}$	The amount of wastewater treated by anaerobic section	m^3	20573.85	Flow meter	Continuous
$COD_{in,INC,y}$	The COD concentration of wastewater at the inlet of anaerobic treatment system	kg COD /m^3	63.93	COD detector	Daily
$COD_{out,INC,y}$	The COD concentration of wastewater at the outlet of anaerobic treatment system	kg COD /m^3	7.48	COD detector	Daily
$R_{ww,INC,y}$	Methane recovery	kgCH_4	79333.84	Flow meter	Continuous
$V_{BGS\_FL,INC,y}$	The amount of biogas sent to the flare	Nm^3	140947.89	Flow meter	Continuous

Remarks:
1) Since the boundary of the newly-built MSW incineration power plant (grate furnace) exceeds the boundary of the NAMA project, $Q_{INC,y}$ equals to the amount of waste to the furnace * the total amount of waste to the incineration plant in the NAMA project boundary / the total amount of waste to the incineration plant. Other parameters namely $FC_{i,INC,y}$, $EC_{INC,y}$, $ES_{INC,y}$, $HS_{INC,y}$ $W_{INC,y}$ $R_{ww,INC,y}$ and $V_{BGS\_FL,INC,y}$ are calculated in the same manner.
2)Tai'an did not carry out the monitoring of waste components during the monitoring period. According to the research results of the three monitoring periods, the waste components are very important for the calculation results of emission reductions. Moreover, with the continuous economic improvement, the data of waste components obtained by Tai'an in 2018 can no longer reflect the current actual situation. At present, only Suzhou and Bengbu of the five demonstration cities have carried out monitoring of waste components in accordance with the requirements. Considering that Tai'an's development level of economy is similar to that of Bengbu, Tai'an's waste components use Bengbu monitoring data.
3) The amount of heat supplied to the users is calculated based on the steam amount and enthalpy (heat content). The incineration plant supplied steam (210℃, 1.3 MPa) with the enthalpy of 2834.06 kJ/kg.

Through on-site visits, review of supporting documents such as calibration reports, the project team confirmed that except for the waste composition, other parameters of the monitoring such as equipment accuracy, calibration standards and frequency were consistent with the monitoring plans.

2.4 Lanzhou

From 07/06/2021 to 09/06/2021, the project team conducted the fourth monitoring and evaluation in Lanzhou. Through on-site investigation and review of the supporting documents such as Statistics Table, Plant Electrical Equipment Statistics Table, Vehicle Refueling Details and other documents, the project team confirmed that the data and parameters monitored are as follows:

Table 2-12 Monitoring information of the emission reduction project of the 20t/d Organic Waste Treatment Station in Lanzhou

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{COMP,y}$	Quantity of waste composted	t	2159.54	Weighbridge	Real-time
$EC_{COMP,y}$	Electricity consumption	MWh	149.22	Electricity meter	Continuous
$FC_{i,com,y}$	Diesel consumption	t	4.88	Weighbridge	Each purchase
$P_{OFS,y}$	Organic fertilizer production	t	587.92	Weighbridge	Real-time

Remarks:
1) The project team only obtained data on the cost of diesel consumption. The unit conversion is based on the unit price of 5.68 yuan/L and the density of 0.84 kg/L during the monitoring period.
2) When calculating CO_2 emission reductions from organic fertilizer instead of chemical fertilizer, it is assumed that the chemical fertilizer efficiency is 2.8 times higher than that of organic fertilizer.

Table 2-13 Monitoring information of the emission reduction project of the 50t/d Bulky Waste Treatment in Lanzhou

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{bg,y}$	Quantity of bulky waste	t	2869.35	Weighbridge	Real-time
$EC_{pbg,y}$	Electricity consumption of bulky waste crushing pretreatment	MWh	37.58	Electricity meter	Continuous
$EC_{fbg,y}$	Electricity consumption during the molding process of biomass solid briquettes	MWh	258.24	Estimated value	/
$P_{bsbf,y}$	Biomass solid briquette production	t	1859.34	Calculated value based on experience	/

Remarks:

1) The bulky waste treatment station in Anning District of Lanzhou crushes and pre-processes the bulky waste into small pieces at first, and then sells it to the downstream to produce biomass solid briquette fuel. The replacement of coal by biomass solid briquette fuel will reduce greenhouse gas emissions. However, the company is unable to grasp the power consumption and biomass solid briquette production data in the production of biomass solid fuels at present. This monitoring period is estimated based on relevant standards and research results. The specific process is as follows:

a) Electricity consumption: According to the "NY/T 2705-2015 Biomass Fuel Molding Machine Quality Evaluation Technical Specification" Table 3, the maximum electricity consumption of granular materials per ton is 90kWh/t.

b) The production of biomass solid briquettes: For 1 ton of bulky waste, removing 10% loss and iron content, deducting 10% moisture content, and the yield rate is about 80%.

2) The emission reductions generated by the replacement of coal by biomass solid briquettes: Based on the combustion of 1 ton of biomass solid briquettes equivalent to 0.8 tons of standard coal, and the combustion of each ton of standard coal emits about 2.6 tCO_2e.

Through on-site visits, review of supporting documents such as calibration reports, the project team confirmed that the accuracy, calibration standards and frequency of the monitoring equipment were consistent with the monitoring plans in Anning District Organic Waste Treatment Station. In addition, the bulky waste treatment station in Anning District is a newly commissioned project with a new monitoring plan. The project team will evaluate the accuracy, calibration standards, frequency and other information of its monitoring equipment for compliance with the monitoring plan during the subsequent monitoring period.

2.5 Bengbu

From 15/06/2021 to 16/06/21, the project team conducted the fourth monitoring and evaluation in Bengbu. Through on-site investigation and review of the supporting documents such as Production Report and Leachate Treatment Station Operation Report, the project team confirmed that the data and parameters monitored are as follows:

Table 2-14 Monitoring information of the newly built MSW Incineration Power Plant (Grate Furnace) in Bengbu

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{INC,y}$	The amount of waste treatment by incineration (to the furnace)	t	189850	Weighbridge	Each trip
$P_{j,y}$	Proportion of waste composition j	/	Textile: 9.13% (Moisture content40.05%) Food waste:18.94% (Moisture content78.77%) Rubber and leather: 5.21% (Moisture content0) Plastic:17.07% (Moisture content38.45%) Metal:4.65% (Moisture content5.12%) Glass: 8.53% (Moisture content6.11%) Others (excluding paper and wood): 15.75% (Moisture content10.7%)	Split hole screen, weighbridge, platform scale	Every three months
$FC_{i,INC,y}$	Diesel consumption	t	210.7	Weighbridge	Each purchase
$EC_{INC,y}$	Electricity consumption	MWh	0	Electricity meter	Continuous
$ES_{INC,y}$	The amount of electricity to the grid	MWh	77535	Electricity meter	Continuous
$W_{INC,y}$	The amount of wastewater treated by anaerobic section	m^3	60685	Flow meter	Continuous
$COD_{in,INC,y}$	The COD concentration of wastewater at the inlet of anaerobic treatment system	kg COD /m^3	29.257	COD detector	Daily
$COD_{out,INC,y}$	The COD concentration of wastewater at the outlet of anaerobic treatment system	kg COD /m^3	3.263	COD detector	Daily
$R_{ww,INC,y}$	Methane recovery	kgCH_4	234484	/	/
$V_{BGS\_FL,INC,y}$	The amount of biogas sent to the flare	Nm^3	545058.12	/	/

Remark:
1) The amount of biogas recovered was not monitored and is calculated according to the empirical formula for incineration plants: (leachate stock COD - anaerobic tank effluent COD)/1000*0.35* anaerobic tank water inflow. The value is converted according to the methane density of 0.717 kg/m^3 under standard conditions and the proportion of methane in biogas. Since the amount of biogas sent to flare was not monitored, the amount of biogas recovered was used.

Table 2-15 Monitoring information of newly built Restaurant Waste Treatment Plant (Phase I) in Bengbu

Data and parameters monitored	Description	Unit	Value	Monitoring equipment	Monitoring frequency
$Q_{wt,AD,y}$	The amount of waste treatment in anaerobic digesters	t	16715.28	Electronic truck scale	Real-time
$V_{BGS,AD,y}$	The amount of biogas collected at the digester outlet	Nm^3	814191	Flow meter	Continuous
$V_{CH4\_FL,AD,y}$	Volumetric flow of the biogas sent to the flare	Nm^3	407095.5	/	/
$F_{CH4,AD,y}$	Fraction of methane in biogas	/	56.1	Gas analyzer	Real-time
$EC_{AD,y}$	Electricity consumption	MWh	821.53	Electricity meter	Continuous
$BDS_{PJ,y}$	Grease production	t	492.42	Weighbridge	Real-time

Remarks:

1) Biogas sent to the flare was not measured, so it is equal to the total amount of collected biogas minus the amount of biogas sent to the boiler, while latter was not monitored and estimated based on operation records.

2) When calculating CO_2 emission reductions from biodiesel instead of diesel, the biodiesel output is converted as 90% of the grease production.

Through on-site visits, review of supporting documents such as calibration reports, the project team confirmed that except for the amount of biogas sent to the flare, other parameters of the monitoring such as equipment accuracy, calibration standards and frequency of the monitoring equipment were consistent with the monitoring plans.

3 Emission reduction assessments

3.1 Suzhou

During this monitoring period, the emission reductions in the collection and transportation and recycling process was not included in the assessment of Suzhou. The emission reduction projects in the waste treatment/disposal process were the newly built Agricultural Market Waste Treatment Station, Industrial Park Restaurant Waste Treatment Plant, Qizishan Landfill Power Generation Plant project, High-tech Zone Restaurant Waste Treatment Plant and expansion of Everbright Environment Energy MSW Incineration Power Plant. According to the baseline study report, the baseline scenario for the projects was "landfill + incineration".

Based on the formula (34) of the MRV model and the calculation steps of the newly-built agricultural market waste treatment stations replacing "landfill + incineration" in the baseline study report, the project team calculated the emission reductions from the Agricultural Market Waste Treatment Station. Based on the formula (27) of the MRV model the calculation steps of the expansion of the MSW Incineration Power Plant replacing "landfill + incineration" scenario in the baseline study report, the project team calculated the emission reductions from expansion of the incineration power plant. Emission reductions achieved from operation of the Qizishan Landfill Power Generation Plant, Industrial Park Restaurant Waste Treatment Plant and High-tech Zone Restaurant Waste Treatment Plant were calculated based on the formulas (7) ~ (11), (26) and (28) of the MRV model. The detailed calculation process is provided in the emission reductions calculation table (Version 01, 02/08/2021) for the fourth monitoring period in Suzhou. The table is submitted as an annex to the report.

During the monitoring period, the emission reductions in the waste management processes in Suzhou were as follows:

Table 3-1 Summary of emission reductions for waste management processes in Suzhou（unit：tCO2e）

Waste management		Baseline emissions	Project emissions	Emission reductions
Collection and transportation		/	/	/
Waste treatment/ disposal	Agricultural Market Waste Treatment Station	2076	-152	2228
	Qizishan Landfill Power Generation Plant	4227	-8979	13206
	Industrial Park Restaurant Waste Treatment Plant	44069	922	43147
	High-tech Zone Restaurant Waste Treatment Plant	33759	102	33657
	Expansion of Everbright Environment Energy MSW Incineration Power Plant	233974	177483	56491
Recycling		/	/	/
Total				148729

3.2 Xi'an

During this monitoring period, the emission reductions in the collection and transportation and recycling process was not included in the assessment of Xi'an. The emission reduction projected in the waste treatment/disposal process was caused by the newly constructed Restaurant Waste Treatment Plant (Phase I), MSW Incineration Power Plant in Gaoling District, MSW Incineration Power Plant in Huyi District, MSW Incineration Power Plant in Lantian Country and MSW Incineration Power Plant in Xixian District. According to the baseline study report, the baseline scenario for the project was "landfill".

Based on the formula (28) of the MRV model and the calculation steps for the emission reductions from the Restaurant/Kitchen Waste Treatment Plant (Phase I) of the baseline study report, the project team calculated the emission reductions from the waste treatment plant. Based on the formula (27) of the MRV model and the calculation steps for the emission reductions from the MSW incineration power plant compared to the baseline study report, the project team calculated the emission reductions from the newly build MSW Incineration Power Plant in Gaoling District, Huyi District, Lantian Country and Xixian District respectively. The calculation process is provided in the emission reductions calculation table (Version 01, 02/08/2021) for the fourth monitoring period in Xi'an. The table is submitted as an annex to the report. During the monitoring period, the emission reductions in the waste management processes in Xi'an were as follows:

Table 3-2 Summary of emission reductions for waste management processes in Xi'an（unit：tCO2e）

Waste management		Baseline emissions	Project emissions	Emission reductions
Collection and transportation		/	/	/
Waste treatment/ disposal	Restaurant Waste Treatment Plant (Phase I)	36569	-6325	42894
	Xi'an Jingwei Kangheng Environmental Energy Co., Ltd. - MSW Incineration Power Plant Gaoling District	283812	100825	182987
	China Energy Conservation and Environmental Protection Group (Xi'an) - MSW Incineration Power Plant Huyi District	284821	113628	171193
	Everbright Environmental Energy (Lantian) Co., Ltd.-MSW Incineration Power Plant Lantian County	322091	110611	211480
	Beijing Enterprises Environmental Protection Technology Development Co., Ltd. - MSW Incineration Power Plant Xixian District	408986	158163	250823
Recycling			/	/
Total				859377

3.3 Tai'an

During this monitoring period, the emission reductions in the collection and transportation and recycling process was not included in the assessment of Tai'an. The emission reduction project in the waste treatment/disposal process was a newly built MSW Incineration Power Plant (Grate Furnace). According to the baseline study report, the baseline scenario for the project was "MSW Incineration Plant (Circulating Fluidized Bed)".

Based on the formula (27) of the MRV model and the calculation steps for the emission reductions from the newly built MSW Incineration Power Plant (Grate Furnace) compared to the baseline study report, the project team calculated the

emission reductions from the incineration power plant. The calculation process is provided in the emission reductions calculation table (Version 01, 02/08/2021) for the fourth monitoring period in Tai'an. The table is submitted as an annex to the report. During the monitoring period, the emission reductions in the waste management processes in Tai'an were as follows:

Table 3-3 Summary of emission reductions for waste management processes in Tai'an（unit：tCO2e）

Waste management		Baseline emissions	Project emissions	Emission reductions
Collection and transportation		/	/	/
Waste treatment/ disposal	MSW Incineration Power Plant (Grate Furnace)	93541	37079	56462
Recycling		/	/	/
Total				56462

3.4 Lanzhou

During this monitoring period, the emission reductions in the collection and transportation and recycling process was not included in the assessment of Lanzhou. The emission reduction project in the waste treatment/disposal process was the newly built Anning District organic waste treatment station and newly built Anning District bulky waste treatment station. According to the baseline study report, the baseline scenario for the project was "landfill + incineration".

Based on the formula (34) of the MRV model etc., the project team calculated the emission reductions from the 20t/d organic waste treatment station and the 50/t bulky waste treatment station. The calculation process is provided in the emission reductions calculation table (Version 01, 02/08/2021) for the fourth monitoring period in Lanzhou. The table is submitted as an annex to the report. During the monitoring period, the emission reductions in the waste management processes in Lanzhou were as follows:

Table 3-4 Summary of emission reductions for waste management processes in Lanzhou（unit：tCO2e）

Waste management		Baseline emissions	Project emissions	Emission reductions
Collection and transportation		/	/	/
Waste treatment/ disposal	Anning District Organic Waste Treatment Station	1789	-355	2144
	Anning District Bulky Waste Treatment Station	2376	-3681	6057
Recycling		/	/	/
Total				8201

3.5 Bengbu

During this monitoring period, the emission reductions in the collection and transportation and recycling process was not included in the assessment of Bengbu. The emission reduction project in the waste treatment/disposal process was the newly built MSW Incineration Power Pant (Grate Furnace, Phase I) and Restaurant Treatment Plant (Phase I). According to the baseline study report, the baseline scenario for the project was "landfill".

Based on the formula (27) of the MRV model and the calculation steps for the emission reductions from the MSW Incineration Power Plant (Grate Furnace) compared to the baseline study report, the project team calculated the emission reductions from the MSW incineration power plant. Based on the formula (28) of the MRV model, the emission reductions from the restaurant waste treatment plant was calculated. The calculation process is provided in the emission reductions calculation table (Version 01, 02/08/2021) for the fourth monitoring period in Bengbu. The table is submitted as an annex to the report. During the monitoring period, the emission reductions in the waste management processes in Bengbu were as follows:

Table 3-5 Summary of emission reductions for waste management processes in Bengbu（unit：tCO_2e）

Waste management		Baseline emissions	Project emissions	Emission reductions
Collection and transportation		/	/	/
Waste treatment/ disposal	MSW Incineration Power Plant (Grate Furnace)	187970	33650	154320
	Restaurant waste Treatment Plant (Phase I)	16550	412	16138
Recycling		/	/	/
Total				170458

4 Evaluation conclusions

Since the emission reduction monitoring and evaluation was launched by the project NAMA in January 2019, the project team has carried out four monitoring periods of monitoring and evaluation work. Based on the assessment results of emission reductions during the three monitoring periods before, waste components have a great influence on the estimation of emission reductions. In addition, as the city's economy continues to develop, Xi'an, Lanzhou, and Tai'an use baseline waste components to assess emission reductions, which may result in the carbon emission intensity per ton of waste that cannot reflect the actual waste treatment/disposal emission intensity level of each city reasonably. Therefore, the data of each municipal waste component has been updated in this monitoring period5, and the baseline emission intensity of each monitoring period has also changed accordingly. This chapter summarizes and analyzes the updated data to form an assessment conclusion.

4.1 Summary of GHG emission reductions

According to the emission reduction evaluation result, the total emission reductions of 1,243,227 tCO2e were achieved in the five demonstration municipalities during the fourth monitoring period. The accumulated total emission reduction during all the monitoring periods is amounted to 3,843,245 tCO2e.

The detailed emission reduction of each city are demonstrated in Table 4-1, comparison and analysis of emission reductions are shown in Fig.4-1 and Fig.4-2.

Table 4-1 Summary of GHG emission reductions

Monitoring period No.	Monitoring period	Suzhou	Xi'an	Tai'an	Lanzhou	Bengbu	Total
01	01/01/2019~30/04/2019	487	21622	22177	/	192614	**236900**
02	01/05/2019~31/10/2019	30918	37853	36837	1109	137396	244113
03	01/11/2019~31/10/2020	330596	1440947	89316	2945	255201	2119005
04	01/11/2020~30/04/2021	148729	859377	56462	8201	170458	1243227
Total		**510730**	**2359799**	**204792**	**12255**	**755669**	**3843245**

5 At present, only Suzhou and Bengbu have carried out the actual measurement of waste components in accordance with the requirements of the "Monitoring Plan". Considering the similarity of economic development level and structure, the waste composition of Xi'an has been updated to the average value measured in Suzhou and Bengbu, and the waste composition of Tai'an and Lanzhou has been updated to measured data in Bengbu.

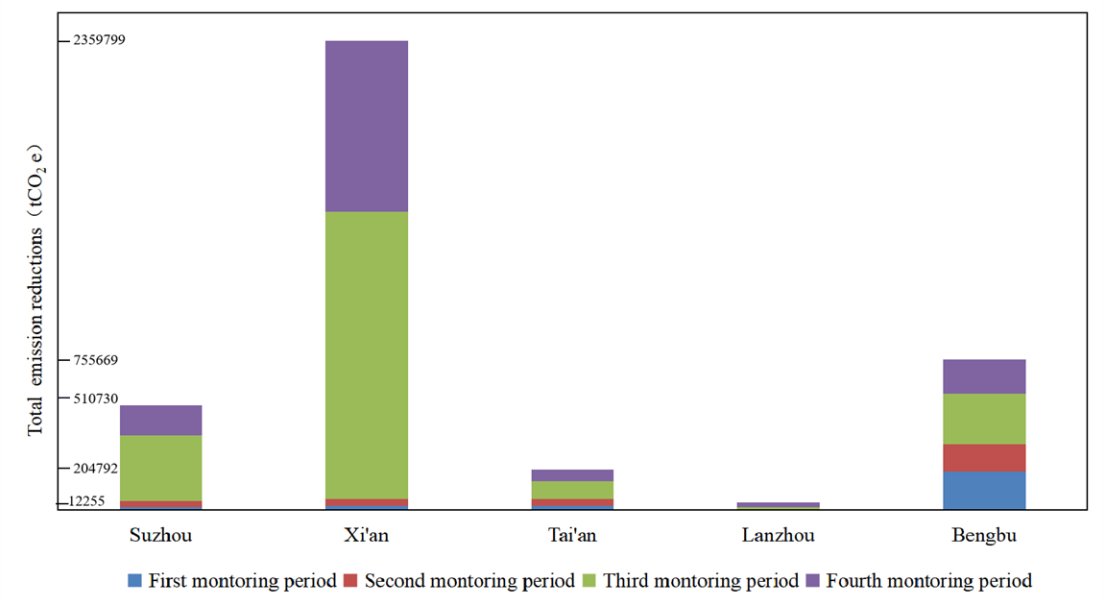

Figure 4-1 Comparison and analysis of total emission reductions by demonstration municipalities

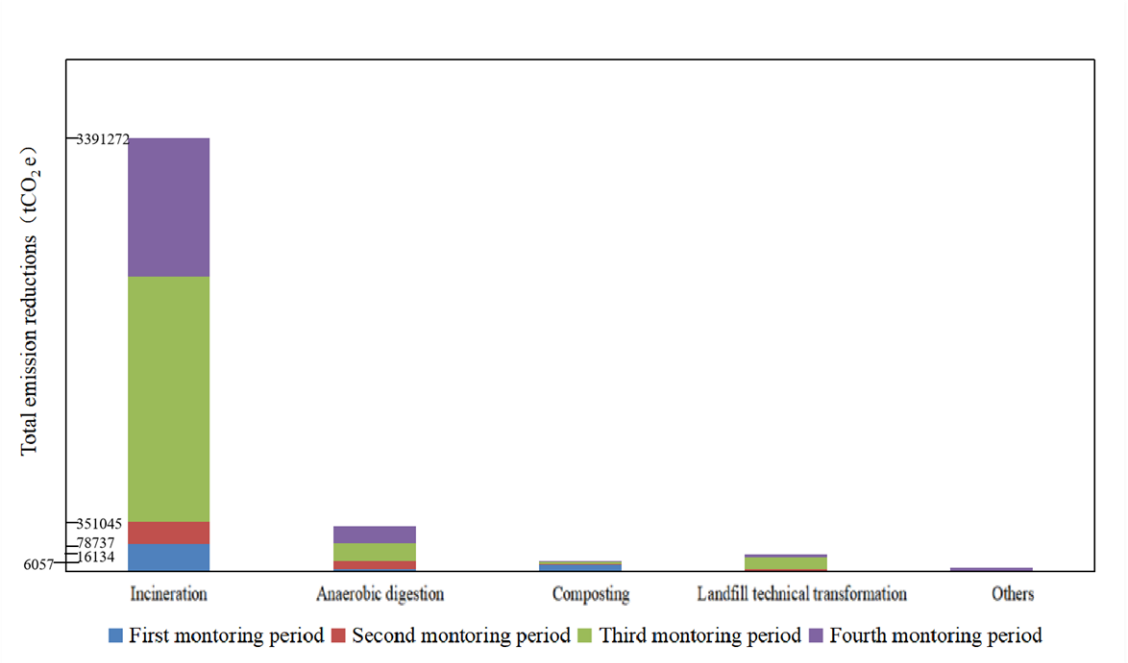

Figure 4-2 Comparison and analysis of total emission reductions by different waste treatment / disposal types

According to the figures shown above, the following conclusions for the fourth monitoring period as well as in general for the four monitoring periods can be made:

1) Xi'an made the biggest contribution to the emission reduction compared to the other four cities, accounting for about 69% of all emission reduction achieved. The main reason is that Xi'an newly commissioned 4 incineration plants during the last monitoring period. Suzhou, Tai'an and Lanzhou correspondingly followed Bengbu by the share of their contribution (Figure 4-1). Lanzhou's emission reduction was the lowest resulting from pending approval of planned emission reduction projects.

2) Among all waste treatment / disposal technologies applied in the demonstration municipalities, the emission reduction attributed to waste incineration were the largest, with exactly 87% followed by anaerobic digestion and technical upgrade at landfills (landfill gas collection and utilization). Other methods such as composting have the smallest emission reductions due to the small processing/disposal scale.

4.2 Comparison and analysis of GHG emission reductions

During this monitoring period, the total emission reduction of the five demonstration municipalities was 28.37% less than the emission reduction estimated in the baseline study report. The comparison of real and estimated GHG emission reductions for each city is shown in Table 4-2.

Table 4-2 Comparison of real and estimated GHG emission reduction for five demonstration municipalities[6]

City	Emission reduction project name	Emission reduction in monitoring period (tCO_2e)	Estimated emission reduction in baseline report[7] (tCO_2e)	Difference ratio
		A	B	C=(A-B)/B
Suzhou	Agricultural Market Waste Treatment Station	2228	21483	-89.63%
	Qizishan Landfill Power Generation Plant	13206	/	/
	Industrial Park Restaurant Waste Treatment Plant	43147	/	/
	High-tech Zone Restaurant Waste Treatment Plant	33657	/	/
	Everbright Environment Energy (Suzhou) Co., Ltd. – Expansion of MSW incineration power plant	56491	271343	-79.18%
Xi'an	Restaurant Treatment Plant (Phase I)	42894	27453	56.25%
	Xi'an Jingwei Kangheng Environmental Energy Co., Ltd.-MSW Incineration Power Plant Gaoling District	182987	280257	-34.71%
	China Energy Conservation and Environmental Protection Group (Xi'an) - MSW Incineration Power Plant Huyi District	171193	261423	-34.51%
	Everbright Environmental Energy (Lantian) Co., Ltd.-MSW Incineration Power Plant Lantian County	211480	275840	-23.33%
	Beijing Enterprises Environmental Protection Technology Development Co., Ltd. - MSW Incineration Power Plant Xixian District	250823	298356	-15.93%
Tai'an	Tai'an Beikong Environmental Energy Development Co., Ltd. -MSW Incineration Power Plant (Grate Furnace)	56462	49012	15.20%

6 Since the estimated emission reductions of newly-built industrial park restaurant waste treatment plant, Newly-built high-tech zone restaurant waste treatment plant, Qizishan landfill power generation plant in Suzhou, Anning district organic waste treatment station and 50t/d Bulky Waste Treatment in lanzhou and Newly-built restaurant treatment plant (Phase I)in Bengbu were not calculated in the baseline study report, the comparison between actual emission reductions of this monitoring period and estimated emission reductions cannot be conducted.

7 This monitoring period (01/11/2020-30/04/2021) covers 6 months, so the data in this column is the estimated semi-annual value from baseline study report.

Lanzhou	Anning District Organic Waste Treatment Station	2144	/	/
	Anning District Bulky Waste Treatment Station	6057	/	/
Bengbu	Bengbu Green Power Renewable Energy Co., Ltd.-MSW Incineration Power Plant (Grate Furnace) Phase I	154320	250385	-38.37%
	Bengbu Wangneng technology Co.,Ltd. - Restaurant Treatment Plant (Phase I)	16138	/	/
Total		1243227	1735552	-28.37%

As shown in the above table, the emission reductions of each demonstration city during the monitoring period and the estimated emission reductions in the baseline study report all have a certain deviation. Except for Xi'an's new kitchen waste treatment plant (Phase I) and Tai'an incineration power plant (grate furnace), the emission reductions have increased compared to estimated data, the actual emission reductions of other projects are lower than the estimated value. The differences between the actual emission reductions and emission reductions estimated in the baseline study report have the following reasons:

(1) **Suzhou**

The emission reductions achieved by the Agricultural Market Waste Treatment Station in Suzhou are 89.63% lower compared to the emission reductions estimated in the baseline study report:

- According to the monitoring and evaluation activity, emissions generated due to electricity consumption of the newly-built agricultural market waste treatment station accounted for 44.80% of their total emissions (emission reductions achieved due to substitution of chemical fertilizer with organic fertilizer produced by the stations are excluded) and this was not included in the baseline study report due to the lack of electricity consumption data. As a result, project emissions are significantly higher than baseline study report estimates.

- The baseline study report estimated that the organic fertilizer production was 0.67 tons per ton of agricultural market waste. However, the actual production of organic fertilizer was 0.203 tons, which correspondingly reduced the volume of emissions avoided due to substitution of chemical fertilizer with organic fertilizer.

- The processing scale of the Agricultural Market Waste Treatment Station is 57 t/d but their operational load rate was only 33.36% during the fourth monitoring period. In the baseline study report the estimated emission reductions were calculated under the scenario full-load operation. There, insufficient waste disposal has also led to an overall decrease in reductions.

The emission reductions generated by expansion of the MSW Incineration Power Plant in Suzhou were 79.18% lower compared to the emission reductions estimated in the baseline study report:

- The upgrading project of expansion of MSW incineration power plant in Suzhou has not been completely finished. In this monitoring period, only the emission reduction of 2250t/d of the expansion part will be calculated, and the baseline study report uses the final design waste treatment scale of 6850t/d when calculating emission reductions. And the difference in treatment scale is an important reason for the difference in emission reduction.

- In Suzhou, waste sorting has gained initial progress and restaurant waste treatment plants were put into operation. Correspondingly, great disparities existed in the proportion of waste composition between this monitoring period and historical years, especially the share of plastic, rising from 13.6 % in historical years to 40.17% in the monitoring period.

The increase in plastic components has led to an increase in project emissions and a decrease in emissions reductions.

(2) **Xi'an**

The emission reductions of the newly built Restaurant Treatment Plant (Phase I) in Xi'an were 56.25% higher compared to that of the baseline study report:

- On the one hand, during the monitoring period, the amount of waste treated is 4.56% higher than the design value in the baseline study report. On the other hand, the biogas residue produced by the project was transported to landfill, while biogas slurry produced was discharged directly into the sewage treatment station, there was no storage process. Therefore, the leakage and discharge caused by the storage of biogas residue and biogas slurry have not been calculated. In the baseline study estimation, this part of the emissions accounted for more than 95% (excluding the emission reductions from power generation instead of grid power and biodiesel instead of diesel). Therefore, the combined effect of these two factors leads to a reduction in project emissions and an increase in baseline emissions, which in turn leads to an increase in emissions reductions.

The emission reductions generated by the newly built MSW Incineration Power Plant Gaoling District in Xian, Huyi District, Lantian Country and Xixian District were 34.71%, 34.51%, 23.33% and 15.93% lower compared to the emission reductions estimated in the baseline study report, respectively:

- Compared with the design value in the baseline study report, the amount of waste treated in incineration plant of Gaoling District, Huyi District, Lantian County and Xixian District decreased by 27.87%, 27.61%, 18.14% and 14.63% respectively. Insufficient waste disposal has led to a significant reduction in emission reductions produced by these 4 incineration plants.

(3) **Tai'an**

Compared with the emission reductions estimated in the baseline study report, the emission reductions of the newly built MSW Incineration Power Plant (Grate Furnace) in Tai'an were 15.20% lower:

- Emission reductions from power generation instead of grid power are 6.36% higher than the design value in the baseline study report.

- During the monitoring period, the incineration plant added heat supply, and the emission reductions from heating supply instead of heat network accounted for 15.54%. However, this part was not included in the baseline study report. Therefore, the combined effect of these two factors leads to a reduction in project emissions and an increase in baseline emissions, which in turn leads to an increase in emissions reductions.

(4) **Bengbu**

The emission reductions generated by the newly built MSW Incineration Power Plant (Grate Furnace) during the monitoring period were 38.37% lower than the emission reductions estimated in the baseline study report:

- The amount of waste treated was 7.51% lower than the design value in the baseline study report.

- In the baseline study report, rubber and plastic in the MSW composition were considered as a single waste stream (with rubber and plastic having equal shares of 50% each). During the fourth monitoring period, the share of rubber and plastic

waste in MSW were monitored and tested separately. It was found that the proportion of plastic waste (generating much higher GHG emissions than rubber when incinerated) was larger than the proportion of rubber waste, which led to overall higher total emissions associated during the operation of the incineration plant.

- During the monitoring period, the proportion of inert wastes (glass, plastic, metal, etc.) in the garbage increased, from 17.3% in the baseline study report to 40.6% in the monitoring period, resulting in a decrease of baseline emissions.

These three factors have led to a reduction in baseline emissions and an increase in project emissions, which in turn led to a reduction in emissions reductions.

4.3 Comparison and analysis of GHG emission intensity

During the China NAMA implementation period, the major emission reduction projects in the five demonstration municipalities were newly built/expanded incineration plants, restaurant/kitchen waste treatment plants and composting stations， etc. To compare the contribution of various waste treatment/disposal technologies in the demonstration municipalities to the overall goal of low-carbon development, the project team calculated the emission intensity per ton of waste treated/disposed according to the technology applied in each municipality during the monitoring period. The comparison was supplemented by analysis of waste composition, energy efficiency (e.g., electricity supply to the grid) per ton of waste，the utilization of outputs and other indicators influencing the emission intensity.

(1) Incineration

Among the five demonstration municipalities, Suzhou, Tai'an and Lanzhou already had incineration plants under operation during 2015~2017. Bengbu Incineration Plant8, Tai'an Incineration Plant (grate furnace technology), Xi'an (Gaoling, Huyi, Lantian, Xixian) new incineration plants, and Suzhou expansion incineration plants were monitored and evaluated as emission reduction projects. The project team compared the emission intensities during the monitoring period and analyzed the reasons for the differences. The details are as follows:

Table 4-3 Comparison and analysis of emission intensity and electricity supplied to the grid per ton of waste incineration treatment in demonstration municipalities

Incineration plants in various cities	Monitoring period	
	The emission intensity per ton of waste treatment	Electricity supplied to the grid of per ton of waste treatment
	tCO_2e/t	kWh/t
Suzhou	0.4539	497
Tai'an	0.1833	318
Lanzhou	0.2059	397
Bengbu	0.1772	408
Xi'an (Gaoling),	0.3404	472
Xi'an (Huyi)	0.3823	415
Xi'an (Lantian)	0.3291	500
Xi'an (Xixian)	0.3706	436

8 It was put into operation at the end of 2017, but the operation time in 2017 was short, so the project team considered it as an emission reduction project. Therefore, the historical waste disposal and emission intensity was not considered.

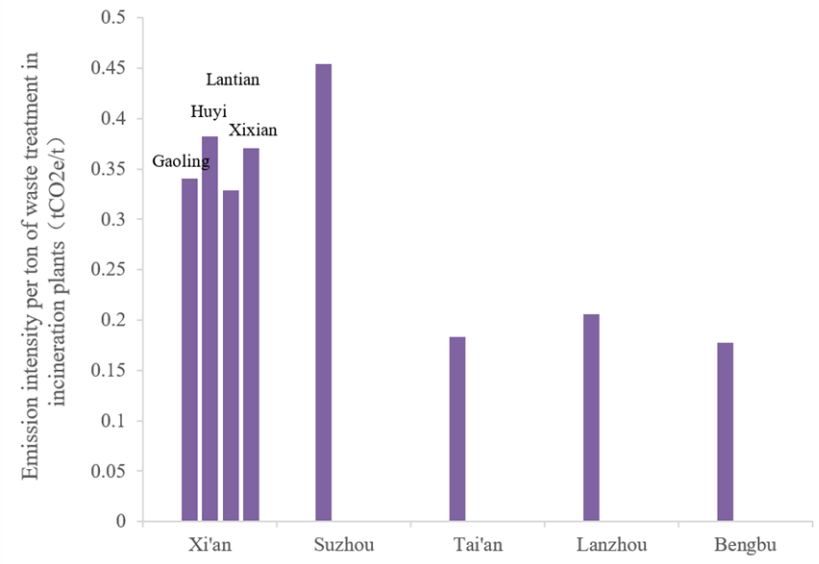

Figure 4-3 Emission intensity per ton of waste treatment in incineration plants

During the monitoring period, the highest emission intensity with respect to waste incineration was recorded in Suzhou and the lowest in Bengbu. The major factors for differences in the emission intensity were: (1) large variation in the amount of electricity supplied to the grid per ton of waste treated; (2) dissimilarities in waste composition. As shown in the Table 4-4, among the five demonstration municipalities, MSW in Suzhou had the largest share of plastic waste. Plastic has the highest fossil carbon content of all components, and a large amount of carbon dioxide is produced during incineration, which leads to an increase in emission intensity.

Table 4-4 Comparison and analysis of the proportion of waste composition across the demonstration municipalities

Waste composition	Suzhou	Xi'an	Tai'an	Lanzhou	Bengbu
Food waste	39.13%	29.04%	18.94%	18.94%	18.94%
Rubber	0.00%	2.61%	5.21%	5.21%	5.21%
Plastic	40.17%	28.62%	17.07%	17.07%	17.07%
Textile	6.29%	7.71%	9.13%	9.13%	9.13%
Others (excluding paper and wood)	0.76%	8.26%	15.75%	15.75%	15.75%
Metal	0.43%	2.54%	4.65%	4.65%	4.65%
Glass	0.96%	4.75%	8.53%	8.53%	8.53%

(2) Anaerobic digestion (AD)

2015-2017, restaurant waste treatment plants already existed in Suzhou, Tai'an and Lanzhou. Suzhou Industrial Park, High-tech Zone Kitchen Factory, Xi'an New Kitchen Waste Treatment Plant (Phase I), and Bengbu newly built Kitchen Waste Treatment Plant (Phase I) are evaluated as emission reduction projects. The project team compared the emission intensity of kitchen waste treatment plants in each demonstration city during the monitoring period and analyzed the reasons for the gap. The specific results are as follows:

Table 4-5 The Emission intensity of restaurant waste treatment plants in the demonstration municipalities during the monitoring period

Restaurant waste treatment plants	Emission intensity (tCO_2e/t)
Xi'an	-0.1657
Tai'an	0.1367
Lanzhou	-0.1647
Bengbu	0.0246
Suzhou (Qizishan)	-0.1069
Suzhou (Industrial Park)	0.0125
Suzhou (High-tech Zone)	0.0018

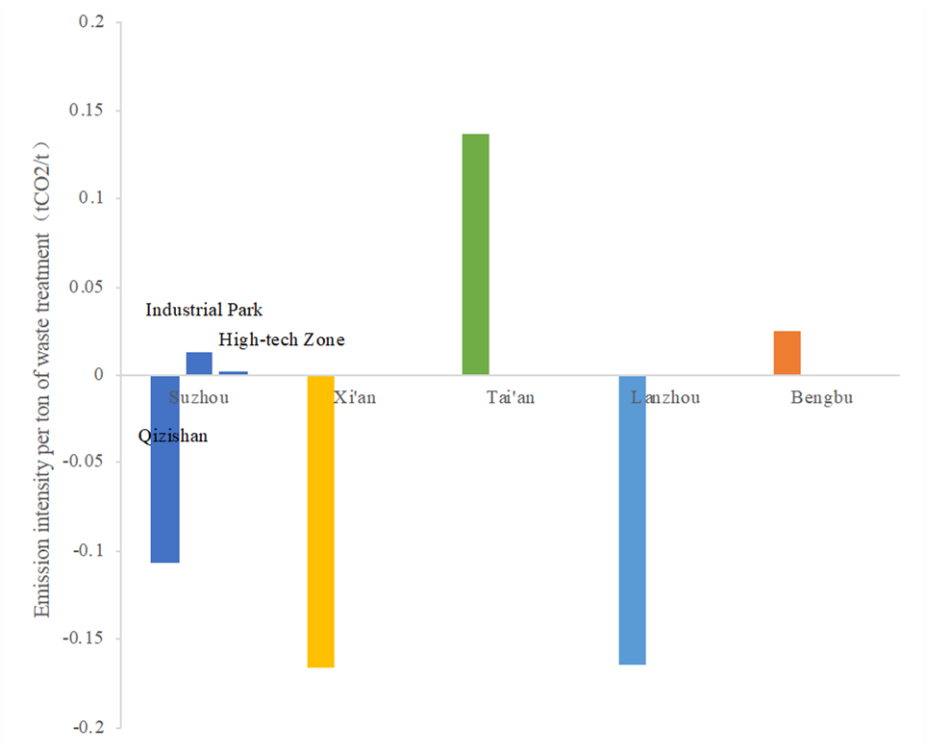

Figure 4-4 The Emission intensity of restaurant waste treatment plants in the demonstration municipalities during the monitoring period

During the monitoring period, Suzhou Qizishan, Xi'an, and Lanzhou showed the negative emission intensities of restaurant waste treatment plants, while Tai'an had the highest emission intensity. The phenomenon mainly stems from the utilization level of outputs: the emission intensity of the Restaurant Waste Treatment Plant will be lower when it has more sufficient utilization of outputs.

In Lanzhou, crude oil, biogas slurry and biogas residue were all recycled and utilized; In Xi'an and Suzhou Qizishan Plant, the yield of crude oil reaches 66% and 61% of total crude oil, respectively. In Tai'an, emission reductions generated from biodiesel production and biogas were not considered. The reason is that monitoring data of biodiesel production was missing, and biogas was utilized for internal heating.

Table 4-6 demonstrates the utilization of outputs such as biogas, biogas slurry, biogas residues generated in the process of anaerobic digestion, and grease from waste oil treatment at restaurant waste treatment plants.

Table 4-6 Output utilization at restaurant waste treatment plants in the demonstration municipalities

Resource-produced product utilization	Suzhou			Xi'an	Tai'an	Lanzhou	Bengbu
	Industrial Park	Qizishan Plant	High-tech Zone				
Biogas	Purified biogas replaces natural gas	Power generation for own use	Power generation for own use	Heating for own use and electricity supplied to the grid	Heating for own use	Heating for own use[9]	For boiler partially
Grease	Biodiesel	Biodiesel	Biodiesel	Biodiesel	/[10]	Biodiesel	Biodiesel
Biogas slurry	/	/	/	/	/	Organic fertilizers	/
Biogas residue	/	/	/	/	/	Organic fertilizers	/

(3) Composting

During the monitoring period, new agricultural market waste treatment stations with composting technology in Suzhou were launched and a new 20t/d organic waste treatment station with composting technology in Lanzhou were constructed. The emission intensity associated with composting was -0.0438tCO_2e/t in Suzhou and -0.1645tCO_2e/t in Lanzhou.

The emission intensity difference is mainly attributed to the organic fertilizers yield per ton of waste treatment with 0.20t/t in Suzhou and 0.27t/t in Lanzhou, respectively. The purchased electricity consumption per ton of waste is 0.13MWh/t and 0.07MWh/t respectively.

9 Because of power generation equipment failure at Lanzhou Chinai Restaurant Waste Treatment Plant in October 2018, the biogas power generation has stopped running.

10 The production of biodiesel at Tai'an restaurant waste treatment plant was not considered during the monitoring period due to lack of monitoring data.

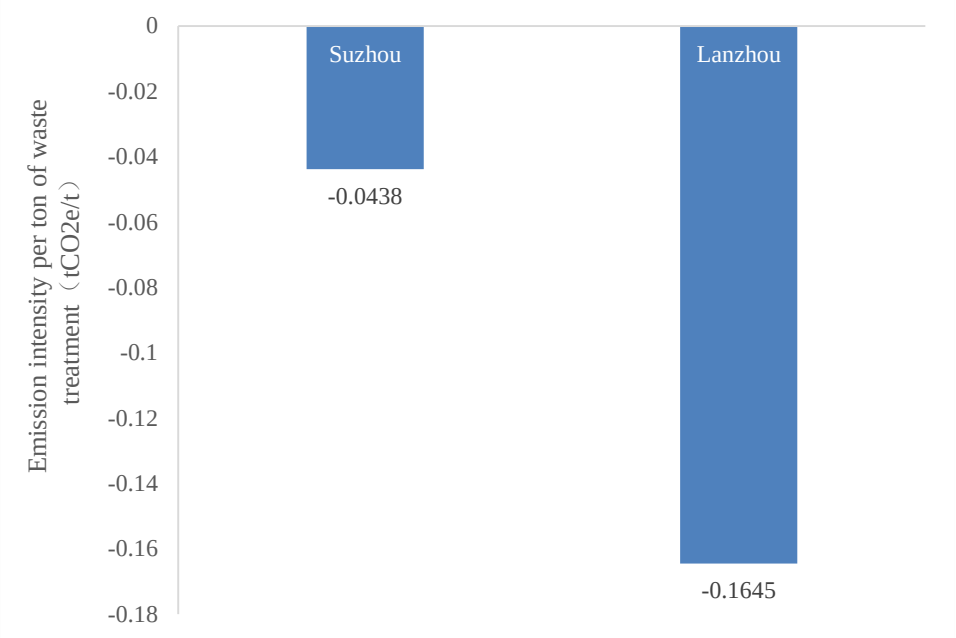

Figure 4-5 The Emission intensity of composting in demonstration municipalities during the monitoring period

4.4 Comparison and analysis of GHG emission intensity of waste treatment for each demonstration municipality

During the monitoring period, the types of waste treatment/disposal in the demonstration municipalities involved landfill, incineration, anaerobic digestion, and composting. At present, the five demonstration cities have basically formed a waste treatment/disposal pattern with mainly waste incineration, supplemented by anaerobic digestion, composting and other methods account for a relatively small proportion.

Table 4-7 Distribution of different waste treatment/disposal in each demonstration municipality during the monitoring period

City	Landfill	Incineration	AD	Composting	Others
Suzhou	/[11]	83.29%	16.41%	0.30%	
Xi'an	/[12]	97.26%	2.74%	/	
Tai'an	/	91.52%	8.48%	/	
Lanzhou	/	84.75%	14.09%	0.50%	0.66%
Bengbu	/	91.91%	8.09%	/	

As mentioned above, the waste component monitoring work carried out by Tai'an during the monitoring period did not meet the requirements of the "Monitoring Plan." Xi'an and Lanzhou did not carry out waste component monitoring work. Suzhou and Bengbu have entrusted a third-party organization to complete the measurement of waste components during

11 Suzhou Landfill is used as an emergency waste treatment facility, including the fly ash from the landfill incineration plant.

12 Xi'an Jiangcungou Landfill will be closed at the beginning of 2020.

the monitoring period. The basic monitoring information is shown in Table 4-8. The project team considers that waste components have a greater impact on the estimation of emission reductions. Therefore, the waste components of the three demonstration cities in Xi'an, Lanzhou and Tai'an have been revised according to the similarity of economic development level and structure. The specific revision details are detailed above. Chapter 4 of the text.

Table 4-8 Compliance with the monitoring requirements on waste composition analysis across the demonstration municipalities

City	Number of samples	Monitoring Frequency	Monitoring standards	Compliance with the monitoring plan
Suzhou	3-5	at least once every three months	CJ/T313-2009	☑ Yes ☐ No
Xi'an	/	/	Not monitored	☐ Yes ☑ No
Bengbu	3	Once every quarter	CJ/T313-2009	☑ Yes ☐ No
Tai'an	1	Once every quarter	Not monitored according to standards	☐ Yes ☑ No
Lanzhou	/	/	Not monitored	☐ Yes ☑ No

The project team calculated the carbon emission intensity of waste treatment/disposal in each demonstration city based on the revised waste composition: Lanzhou 0.1420 tCO_2e/t, Bengbu 0.1649 tCO_2e/t, Taian 0.1794 tCO_2e/t, Xi'an 0.3420 tCO_2e/t, Suzhou 0.4184 tCO_2e/t. The main reason for the difference in carbon emission intensity is the different proportion of plastic. The waste composition of plastic in Suzhou is about 1.4 times that of Xi'an and 2.4 times that of Lanzhou, Bengbu and Tai'an. It is worth noting that Bengbu, Tai'an and Lanzhou which use the same waste composition has different carbon emission intensity. Where Tai'an and Bengbu is similar, Lanzhou is the smallest. This is related to the waste treatment/disposal methods of the three demonstration cities. Among them, incineration in Tai'an and Bengbu accounted for about 91%, anaerobic digestion accounted for about 8%, while incineration in Lanzhou accounted for about 85%, and other treatment/disposal methods such as anaerobic digestion accounted for about 15%. This shows that anaerobic digestion and composting are lower carbon than incineration.

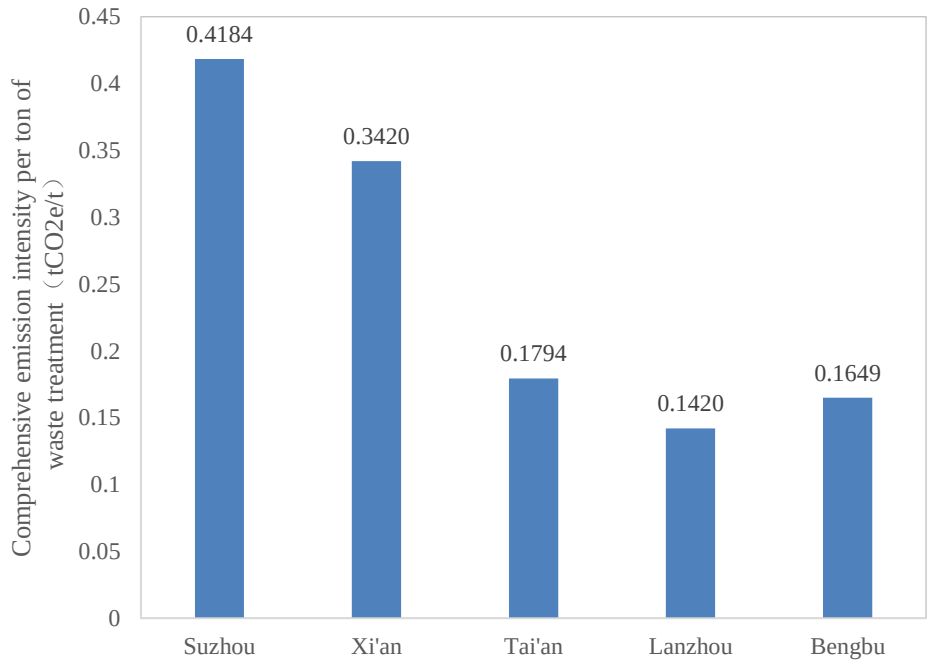

Figure 4-6 GHG emission intensity of waste treatment/disposal in each demonstration municipality during the monitoring period

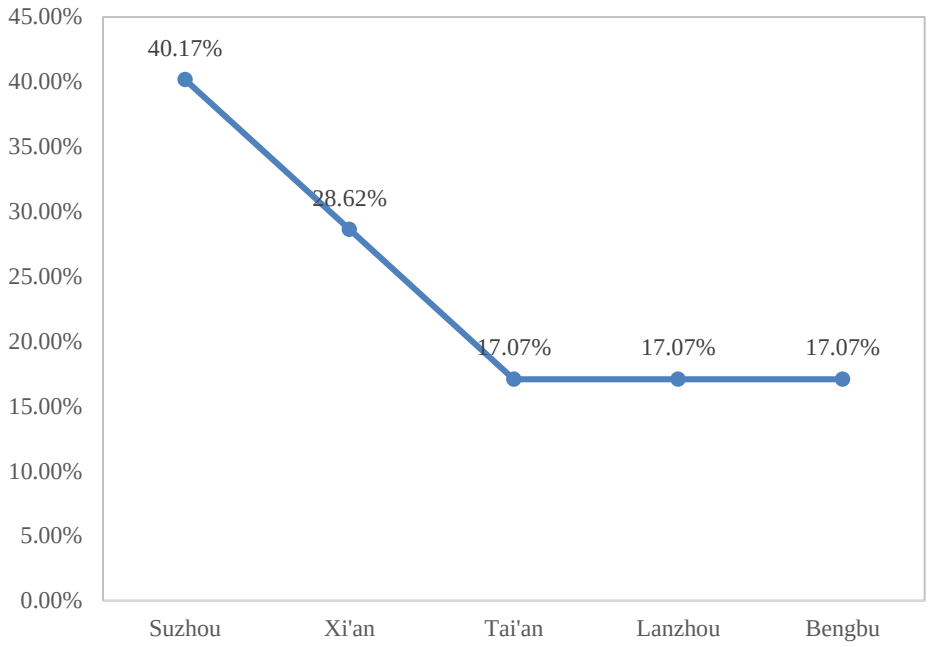

Figure 4-7 Proportion of plastic in waste components of each demonstration city

Through the previous analysis, the waste composition has a greater impact on the intensity of waste disposal per ton of waste in the demonstration city. The main reason is that the economic development levels of the five demonstration cities are different. With the increasing income of residents, the consumption structure of residents has also changed continuously. The various physical components in the garbage have changed to different degrees. The prominent performance is that the rubber and plastics can be recycled13. The content of packaging waste has increased significantly. In this regard, the project team compared the monitoring results of plastic waste components in Suzhou and Bengbu in historical years and 4 monitoring periods. The details are as follows:

13 From "Analysis of Physical Composition and Influencing Factors of Municipal Domestic Waste in Tianjin[J]. Environmental Sanitation Engineering 2014,22(03),12-14"

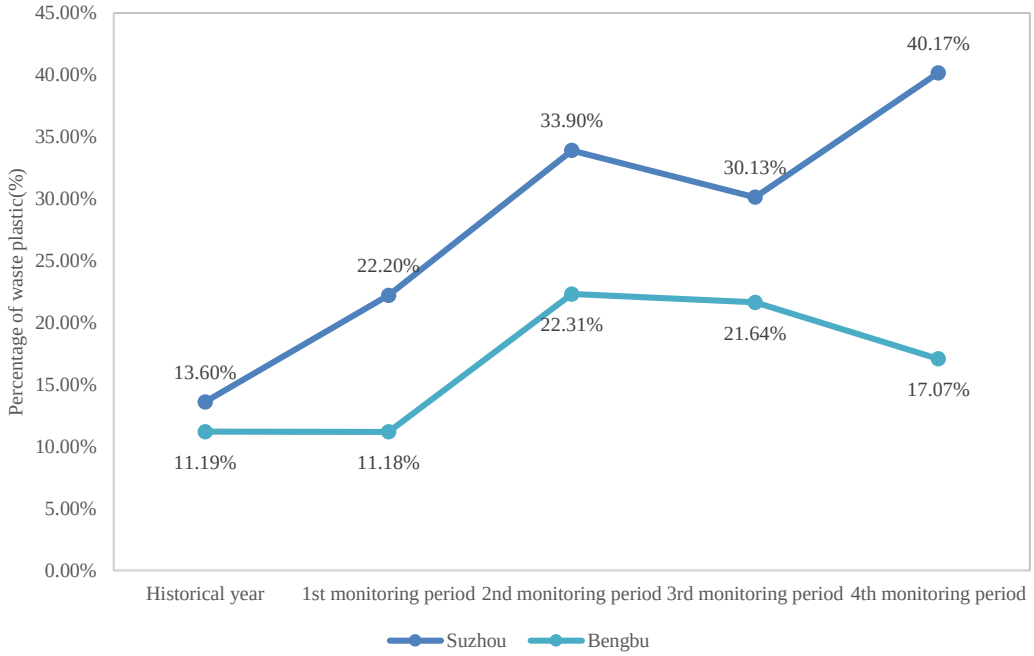

Figure 4-8 Percentage of waste component plastics in each demonstration city

The overall waste plastic components in Suzhou and Bengbu showed an upward trend, which is consistent with the results of related studies. The main reason for the decline in some monitoring periods is that there is a certain randomness in the monitoring and sampling process of waste components. At the same time, it was also verified that "With the continuous development of the economy, Xi'an, Lanzhou and Tai'an use baseline waste components to evaluate emission reductions, which may result in the emission intensity of tons of waste treatment that cannot reasonably reflect the actual waste treatment/disposal emission intensity level". Therefore, it is feasible to correct the waste composition in Xi'an, Lanzhou and Tai'an by using the measured data of waste components in Suzhou and Bengbu during the monitoring period.

In addition, in order to make the low-carbon level of the demonstration cities more comparable, the project team recalculated the carbon emission intensity of the four demonstration cities in Xi'an, Tai'an, Lanzhou and Bengbu based on the waste composition of Suzhou during this monitoring period. The main consideration is that the monitoring data of waste components in Suzhou is relatively complete, and the economic development level of the five cities is the highest. The data is representative of the future development trends of other cities.

Now, the overall emission intensity of waste treatment in Xi'an, Lanzhou Tai'an and Bengbu is higher than that in Suzhou. On the one hand, the level of low carbonization waste treatment/disposal methods in Suzhou is the highest among the five cities under the same waste composition. On the other hand, as the economy is growing, the consumption structure of residents has also changed, the proportion of plastics that affects emissions significantly has increased. As a result, the emission intensity in Xi'an, Lanzhou, Tai'an and Bengbu will also gradually increase, while with the gradual optimization of waste treatment/disposal methods, the emission intensity in Xi'an, Lanzhou and Tai'an may be lower than the calculated data in Fig.4-9 in this scenario.

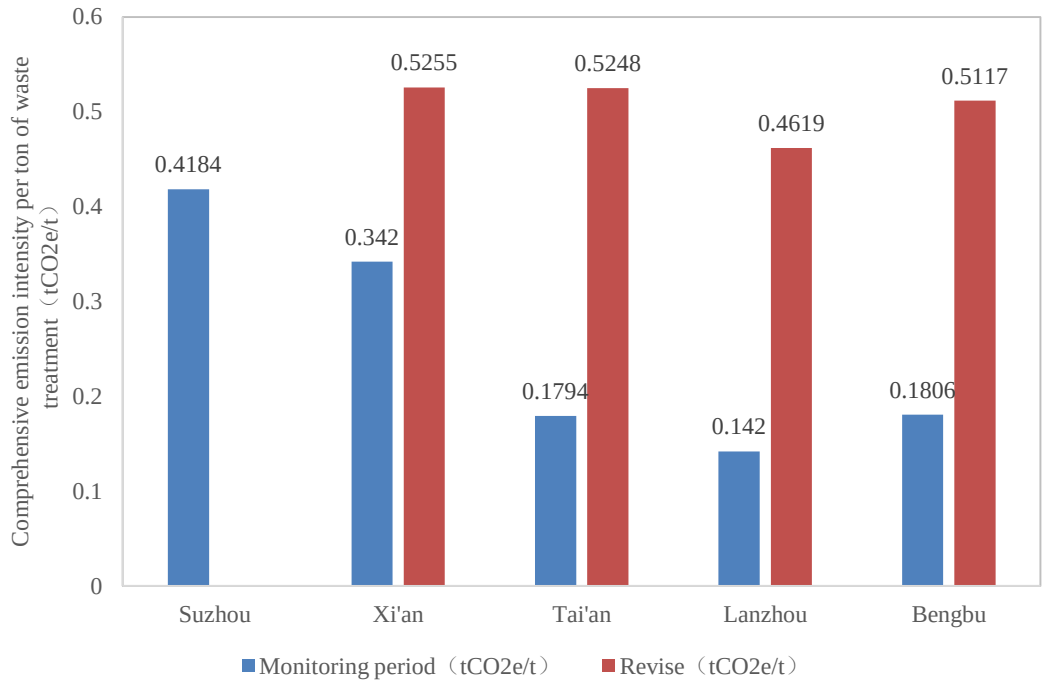

Figure 4-9 GHG emission intensity of waste treatment/disposal in each demonstration municipality during the monitoring period(revise)

4.5 Problems and Suggestions in the evaluation process

A reliable and consistent data monitoring and a comprehensive statistical system are crucial for establishing, maintaining, and improving the quality and level of IWM in the cities. In particular, My country's carbon peak and neutralization goals are proposed. Whether it is to calculate the carbon emissions or the carbon emission reductions generated by the domestic waste treatment industry, accurate data accounting has important reference value. The results of this monitoring and evaluation show that some shortcomings still exist in the demonstration municipalities with respect to the monitoring of waste composition and collecting data on recycling. Therefore, the following recommendations for improving the situation has been made:

(1) The monitoring of waste composition

According to the document "Monitoring Plan", each municipality should carry out monitoring of waste composition in accordance with the relevant standards (CJ/T313-2009). The monitoring frequency should be at least one time in every three months, with at least 3 samples per test. The following levels of compliance with the monitoring requirements on waste composition analysis were recorded across the demonstration municipalities during the monitoring period. See Table 4-8 above for details.

The project team compared the monitoring results during the monitoring period with the historical years and found significant disparities in the waste composition. Therefore, it is recommended that Xi'an, Tai'an and Lanzhou to regularly conduct the monitoring of waste composition in accordance with the requirements of the "Monitoring Plan" to ensure the accuracy of the waste composition. Please refer to Table 4-9.

Table 4-9 Comparison of waste composition of Suzhou, Bengbu, Lanzhou and Xi'an in the monitoring period and in historical years

Waste composition	Suzhou		Bengbu	
	In the monitoring period	In historical years	In the monitoring period	In historical years
Food waste	39.13%	54.42%	18.94%	36.94%
Rubber	0.00%	0.0%	5.21%	11.19%
Plastic	40.17%	13.60%	17.07%	11.19%
Textile	6.29%	2.39%	9.13%	8.24%
Others (excluding paper and wood)	0.76%	6.21%	15.75%	0.14%
Metal	0.43%	4.06%	4.65%	0.26%
Glass	0.96%	0%	8.53%	5.69%

（2）Data on recycling

Calculation of emission reductions generated through recycling is linked to an increase in the recycling rate of four types of recyclables such as wastepaper, waste plastic, waste glass and waste metal in comparison to the baseline. Considering unclear boundary for data collection and gaps in the existing statistical system, the baseline recycling rate cannot be determined yet, thus the emission reductions stemming from waste recycling are not calculated. Currently, the municipal solid waste recycling and data statistics work in Suzhou, Lanzhou and Bengbu has basically formed a model of cooperation between governments and enterprises. Among them, Suzhou is under the responsibility of Su Zaitou Renewable Resources Recovery Management Co., Ltd.; Lanzhou is under the responsibility of the Lanzhou Renewable Resources Recycling Company; Bengbu's statistical caliber has been adjusted several times. This monitoring period is under the responsibility of Shanxi Xinshixian Environmental Technology Co., Ltd., a franchise operated by the Housing and Urban-Rural Development Bureau.

In addition, cities are also actively exploring and innovating in the construction of recycling systems. Representatives of Suzhou and Lanzhou Anning District, are actively responding to the country's policy of "two networks integration":

- Suzhou has built the "Suzhou Municipal Waste Classification Comprehensive Management Platform". The platform is based on the new generation of information technology such as big data, cloud computing, and the Internet of Things, and aims at digitization, modeling and visualization. The multi-level, all-round waste classification management model of "data-based assessment, scientific decision-making, and innovative interaction" comprehensively enhances the ability and level of waste classification management.

- Anning District of Lanzhou built the "Integrated Project of Smart Waste Classification and Circular Economy", which covers functional areas such as a full-cycle intelligent control center, an organic waste intelligent disposal center, a renewable resource sorting center, and a bulky waste dismantling center. It has realized the whole process management and monitoring of waste sorting and placing, waste sorting collection and transportation, and waste sorting treatment for 25,889 residents in 17 communities.

To sum up, the demonstration municipalities of Suzhou, Bengbu and Lanzhou are recommended to improve data collection system, monitoring methods, boundaries definition and data integrity. Meanwhile, Xi'an and Tai'an can refer to the data collecting methods establish their own data collecting method to ensure GHG emission reduction calculation on waste recycling in the coming monitoring period.

（3）Others

The problems in the research on the default value of the low-carbon waste field are consistent with the previous monitoring period.

Appendix I List of new agricultural market waste treatment stations in Suzhou

No	Name	Address	Processing scale	Production time
1	The organic waste treatment station in Xinqi, Wuzhong District	Hou Zhangdun in Xinqi Village	3t/d	May 2018
2	The organic waste treatment station in Jiangwan, Wuzhong District	Jiangwan Village	1 t/d	January 2018
3	The agricultural market waste treatment station in Luzhi, Wuzhong District	Kefu Road	2 t/d	July 2018
4	The organic waste treatment station in Hefeng Village	Hefeng Village	4 t/d	December 2018
5	The agricultural market waste treatment station in Baodai, Wuzhong District	Baodai	5 t/d	December 2018
6	The renewable resource treatment station in Yaofeng, Wuzhong District	Yaofeng Road No.69	8 t/d	2018
7	The agricultural market waste treatment station in Linghudu Village, Wuzhong District	Xinshi Street No. 270	2 t/d	January 2018
8	The Dongshan bureau for environmental health waste treatment station in Wuzhong District	Dongshan Avenue, Fenghuangshan intersection	2.5 t/d	January 2018
9	Treatment point of Lumu Farmer's Market, Xiangcheng District	Yangcheng Lake Middle Road	3 t/d	2018
10	The waste treatment station in resort, Xiangcheng District	Shengtang Road	2 t/d	2018
11	The agricultural market waste treatment station in Dazhuang, Xiangcheng District	The original cattle farm in Xitang River	5 t/d	October 2018
12	The renewable resource treatment center in Xiangcheng and Industrial Park District	200 meters north of Zhu You Dian Zhuang Road, Chunlan Road	4.5 t/d	June 2018
13	The organic waste treatment station in Wangting Town, Xiangcheng District	Former site of Wumenkou Road Central Primary School in Wangting Town	5 t/d	October 2018
14	The Beiqiao Street Bureau for environmental health waste treatment station in Xiangcheng District	North Bridge Street, No. 1 Fei Bird Road	0.5 t/d	October 2018
15	The organic waste treatment station in Qihe, Weitang Town, Xiangcheng District	Weitang Town, Qiahe Village, Qihe Road	0.5 t/d	October 2018
16	The organic waste treatment station in Caohu, Xiangcheng District	/	2 t/d	October 2018
17	The organic waste treatment station in Xinkang, Gusu District	Inside Xinkang Interchange Station	5t/d	April 2019
18	The organic waste treatment station in Guxiang Garden, Gusu District	Inside Guxiangyuan Interchange Station	2t/d	March 2019
Total			57t/d	/

Remark:

With the formal operation of the restaurant waste treatment station in the high-tech zone and the industrial park, 8 agricultural market waste treatment station in Suzhou have been closed. They are as follows:

- The treatment station in Houheben, Xianglu Village, Xiangcheng District.
- The renewable resource treatment station in Zhaiji Villige, Wangting Town, Wuzhong District.
- The organic waste treatment station in Hu Dong Lin Li Center, Industrial Park District.
- The agricultural market waste treatment station in Loufeng Street, Industrial Park District.
- The Chefang agricultural market waste treatment station in Xietang Street, Industrial Park District.
- The Gaobin agricultural market waste treatment station in Weiting Street, Industrial Park District.
- The agricultural market waste treatment station in Industrial Park District.
- Centralized disposal point of perishable garbage in the farmer's market, Gaoxin District.

Appendix II Default values of related parameters

Table 1 Default values associated with waste composition

Waste composition j	Total carbon content percent (FCC_j)	Fossil carbon percent in total carbon content (FFC_j)
Paper/cardboard	50%	5%
Textiles	50%	50%
Food waste	50%	-
Wood	54%	-
Garden and Park waste	55%	0
Nappies	90%	10%
Rubber and leather	67%	20%
Plastics	85%	100%
Metal	NA	NA
Glass	NA	NA
Other, inert waste	5%	100%

Table 2 Other default values

Data and parameters not monitored	Description	Unit	Values
$EF_{CH4,COMP}$	Emission factor of methane (CH_4) per tonne of waste composted valid	tCH_4/t	0.002
$EF_{N2O,COMP}$	Emission factor of nitrous oxide (N_2O) per tonne of waste composted valid	tN_2O/t	0.0002
GWP_{CH4}	Global warming potential of CH_4	tCO_2/tCH_4	25
GWP_{N2O}	Global warming potential of N_2O	$tCO_2/t\ N_2O$	298
EF_{EL}	Electricity emission factor	tCO_2/ MWh	North China：0.75980 East China：0.70285 Northwest China：0.63095
EF_{HS}	Heating emission factor	tCO_2/ GJ	0.11
EF_{CF}	Emission factor of fertilizer production	tCO_2/t	3.341
ρ_{CH4}	Density of methane	kg/m^3	Under normal conditions：0.67 Under standard conditions：0.717
$EF_{CH4,default}$	Default emission factor for the fraction of CH_4 leakage from the anaerobic digester	/	Steel or lined concrete or fiberglass： 0.028
η_{FL}	Flare efficiency	/	Enclosed flare：0.9 Open flare：0.5
$COEF_{die}$	Diesel emission factor	tCO_2/t	3.145
$EFF_{BINC,y}$	Combustion efficiency of incinerators in waste incineration in year y	/	100%

$EF_{CH4,m}$	Methane emission factor associated with waste treatment method m	tCH_4 /waste	$1.21\times 0.2\times10^{-6}$
$EF_{N2O,m}$	N_2O emission factor associated with waste incineration method m	tN_2O/t waste (wet waste)	$1.21\times 50\times10^{-6}$
B_o	Maximum production capacity of methane in anaerobic wastewater treatment system	$kgCH_4$/ kgCOD	0.25
MCF_{WW}	Methane correction factor for anaerobic wastewater treatment system	/	0.8
$F_{LFG,LF,y}$	Fraction of methane in the landfill gas	/	0.5
$F_{BGS,d,y}$	Fraction of methane in the biogas	/	0.6

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
China Integrated Waste Management (IWM) NAMA Project

Tayuan Diplomatic Office Building 2-5, 14 Liangmahe South
Rd, Chaoyang District, 100600 Beijing, PR China

Contact: Dr. Liu Xiao
Tel: +86 (0) 10 8257 5589 ext. 188
Phone: +86 134 8876 0269
E-Mail: xiao.liu@giz.de
Website: www.iwm-nama. org

Website

WeChat