中华人民共和国住房和城乡建设部
Ministry of Housing and Urban-Rural Development (MoHURD)

NAMA Facility

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

中国城市环境卫生协会
China Association of Urban Environmental Sanitation

MSW integrated waste management and low-carbon development — IWM NAMA case study

城市生活垃圾综合管理及低碳发展——IWM NAMA 项目实践

刘晓 博士/项目主任
Dr. LIU Xiao/Project Director

China Integrated Waste Management NAMA

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MSW management and outlook in China
中国生活垃圾管理现状及发展趋势

IWM NAMA Practice on the link of Waste and GHG
IWM NAMA 项目介绍-关于垃圾和应对气候变化

Discussion about what is best practice
关于最佳实践的讨论

MSW management and outlook in China
中国生活垃圾管理现状及发展趋势

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Significance 意义

Basic human right
Yearning for a better life
基本的公众权利
对美好生活的向往

Tidy environment 清洁的环境
Public health 公众健康保障

Important urban infrastructure
重要的城市基础设施

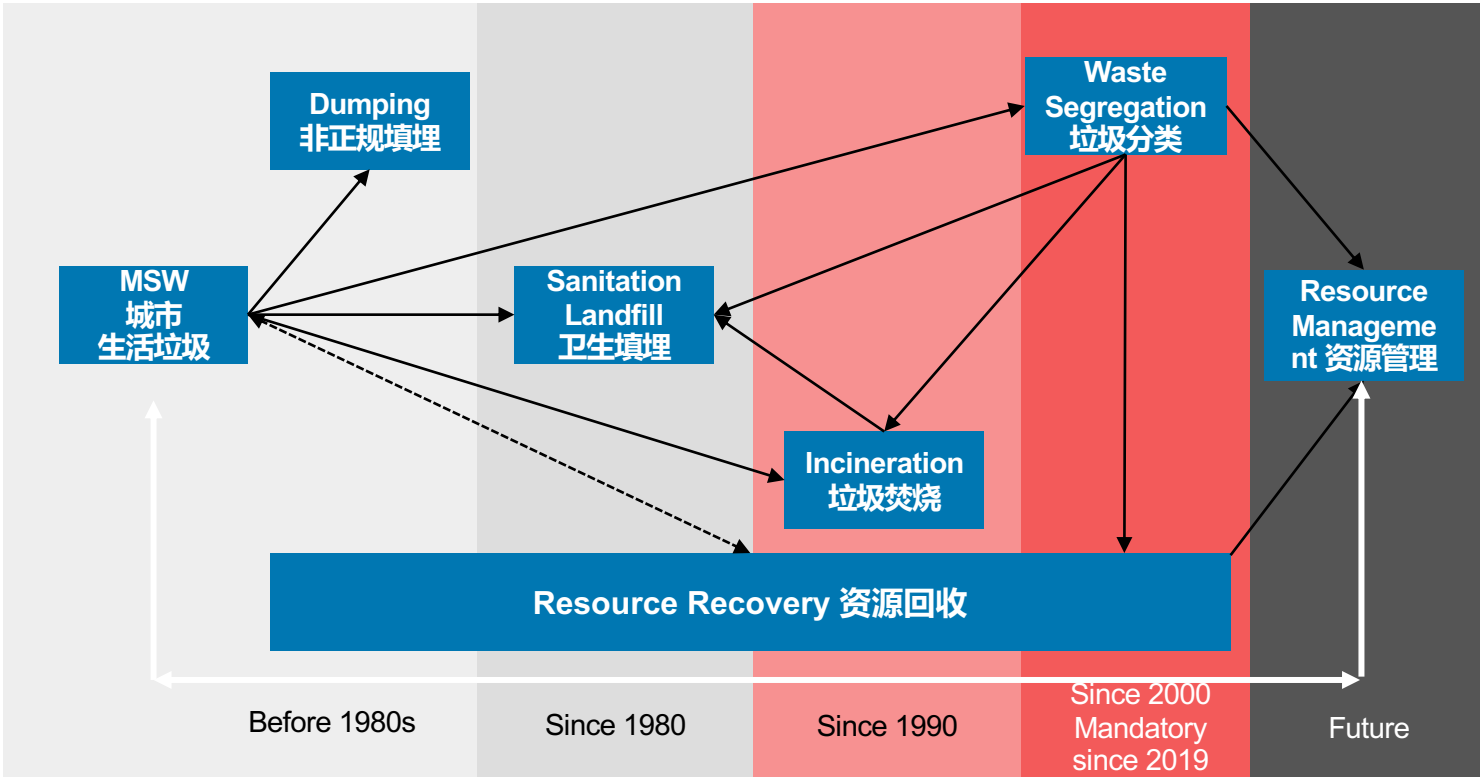
Resources recovery
Good political governance
Sustainable development
可能的资源回收潜力
城市管理水平的直接体现
城市可持续发展的基础条件

Global topic
全球议题

Climate change应对气候变化
Marine litter-Plastic
海洋垃圾—塑料问题

MSW management and sustainable development
城市生活垃圾管理与可持续发展

Development of MSW management in China
中国城市生活垃圾管理发展历程



MSW generation and collection in China
中国城市生活垃圾产生量及清运量

Generation **1.0-1.4** kg/d/capital

每人每天产生**1.0-1.4公斤**垃圾

2018年

Beijing MSW collection

北京生活垃圾清运量：

9.75 Mt　975万吨

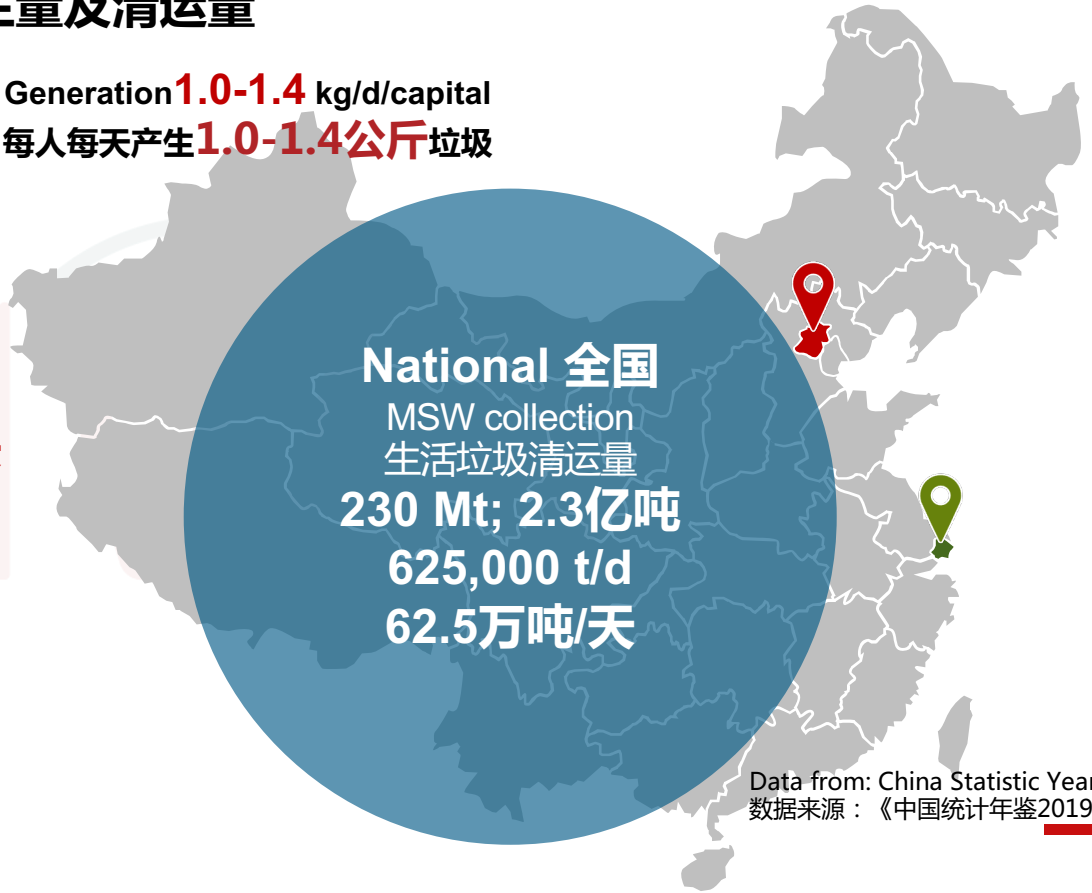
27,000 t/d　2.7万吨/天

Shanghai MSW collection

上海生活垃圾清运量：

7.85 Mt　785万吨

21,000 t/d　2.1万吨/天



Data from: China Statistic Yearbook 2019

数据来源：《中国统计年鉴2019》

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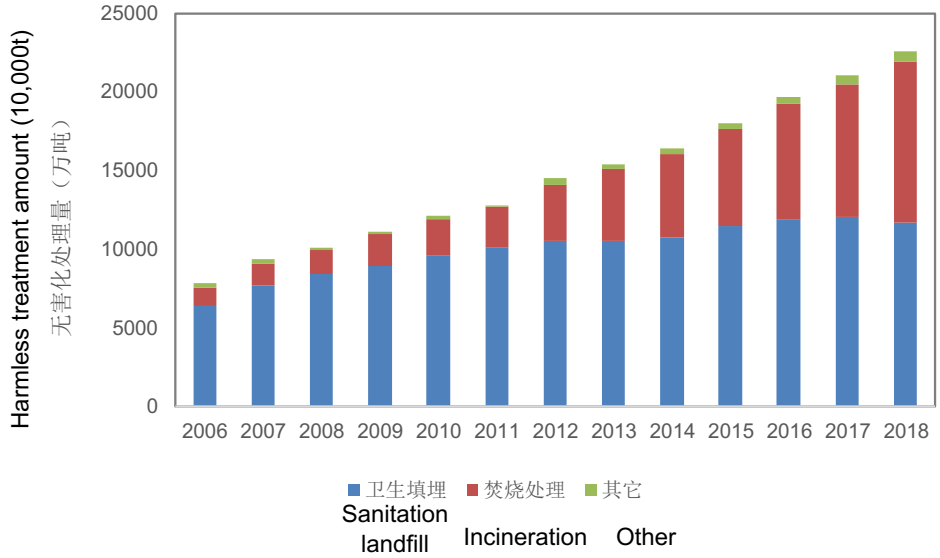
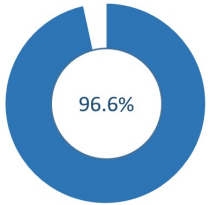
MSW treatment and disposal
城市生活垃圾处理处置

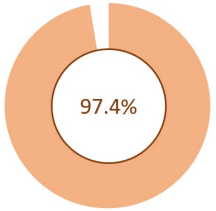


Harmless treatment rate %

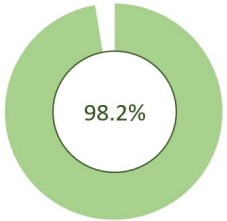
2016年无害化处理率



2017年无害化处理率



2018年无害化处理率



With more than 30 years development, China has achieved the environment soundly treatment and management of MSW, and also provide the basic infrastructure for the future promotion of waste management!

经过超过30年的发展，基本实现了城市生活垃圾的无害化处理！
为垃圾管理水平的进一步提升提供了基本设施保障！

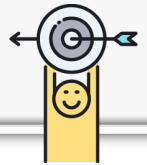
MSW treatment facilities
城市生活垃圾处理处置设施

Future of MSW management in China
城市生活垃圾管理未来？

Further Reduction, Resource recovery
进一步减量化、资源化

Intensive management, high quality development
精细化管理、高质量发展

From linear treatment to circular economy
从线性管理到循环经济



Integrated waste management and low carbon development
垃圾综合管理及低碳发展

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China Integrated Waste Management NAMA
中国城市生活垃圾领域国家适当减缓行动项目

Duration:
- September 2017 – September 2022

Budget:
- 8,000,000 €

Political Partner:
- Ministry of Housing and Urban-Rural Development (MoHURD)

Implementation Partner:
- China Association of Urban Environmental Sanitation (CAUES)

- Client: NAMA Facility

执行期:
- 2017年9月 –2022年9月

预算:
- 8,000,000 €

政府支持单位:
- 中国住房和城乡建设部

执行合作单位:
- 中国城市环境卫生协会

委托方:
- NAMA基金会

China Integrated Waste Management NAMA
中国城市生活垃圾领域国家适当减缓行动项目

Objective:
The NSP will reduce GHG emissions from China's waste sector and induce a transformational change in the sector which will increase the attractiveness of integrated waste management and waste-to-energy systems as a financially sustainable low-carbon investment field.

目标:
通过NAMA项目的执行，减少中国城市生活垃圾行业的温室气体排放；促进中国城市生活垃圾管理行业的变革，建立经济可持续的垃圾低碳综合管理和垃圾能源化利用体系。

Outcome：
Public and private up-scaling throughout China's waste management sector is triggered by replicable flagship cases of integrated waste management systems and waste-to-energy technologies implemented according to BAT and BEP and proven to operate in a financially sustainable way in at least three demonstration municipalities.

成果：
通过最佳可行技术（BAT）和最佳环境实践（BEP）的应用，在至少三个示范城市建立财务可持续的垃圾低碳综合管理以及垃圾能源化利用系统，并以此为案例进行复制推广,提升垃圾行业低碳综合管理能力。

Project Components 项目组成

- PC 1: TA to the Demonstration Municipalities 示范城市技术支持
- PC 2: Policy Advice 政策建议
- PC 3: Analysis of GHG Mitigation Effects 温室气体减缓效果分析
- PC 4: Capacity Development 能力建设
- PC 5: Private Sector Mobilisation 促进私人部门参与

China Integrated Waste Management NAMA
中国城市生活垃圾领域国家适当减缓行动项目

China Integrated Waste Management NAMA

- Tai’an, Shandong Province 山东省泰安市
- Bengbu, Anhui Province 安徽省蚌埠市
- Suzhou, Jiangsu Province 江苏省苏州市
- Xi’an, Shaanxi Province 陕西省西安市
- Lanzhou, Gansu Province 甘肃省兰州市

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China Integrated Waste Management NAMA
中国城市生活垃圾领域国家适当减缓行动项目

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PC3. Analysis of GHG Mitigation Effects
温室气体减排潜力分析

MRV → 基线 Baseline → GHG减排潜力监测 GHG emission reduction monitoring

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PC3. Analysis of GHG Mitigation Effects
温室气体减排潜力分析

No	Emission resources	GHG	land fill	Incin.	AD	Com.
1	CH_4 leakage emissions from landfill	CH_4	√			
2	CH_4 emissions from flaring	CH_4	√	√	√	
3	CO2 emissions from fossil fuel combustion	CO_2	√	√	√	√
4	CO_2 emissions from electricity consumption	CO_2	√	√	√	√
5	CO_2 emissions from incineration	CO_2		√		
6	CH_4 and N_2O emissions from incineration	CH_4 N_2O		√		
7	CH4 emissions from anaerobic digester	CH_4			√	
8	CH4 leakage emissions associated with storage of digestate	CH_4			√	
9	CH_4 and N_2O emissions from the composting	CH_4 N_2O				√
10	CH4 emissions from organic wastewater treatment	CH_4	√	√	√	
11	CO2 emission reductions from power generation instead of grid power	CO_2	√	√	√	
12	CO2 emission reductions from heating supply instead of heat network	CO_2	√	√	√	
13	CO2 emission reductions from purified biogas replaces natural gas	CO_2			√	
14	CO2 emission reductions from biodiesel instead of diesel	CO_2			√	
15	CO_2 emission reductions from organic fertilizers instead of chemical fertilizers	CO_2				√

China Integrated Waste Management NAMA
中国城市生活垃圾领域国家适当减缓行动项目

China Integrated Waste Management NAMA

PC3. Analysis of GHG Mitigation Effects
温室气体减排潜力分析

- Compared with baseline (2015-2017 average), a total **1.4 million tons** CO2e emission reduction has been achieved by the five cities in 2020, equiveillance to 100,000 hectare of forest carbon sink by one year.
- 与基线相比（2015-2017年平均值），2020年，五个示范城市累计减排量**140万吨**CO_{2e}，相当于140万亩植树造林一年的碳汇总量。
- From baseline to 2020, the GHG emission density decreased from **0.8** to **0.5**tCO_{2e}/t MSW.
- 从基线（2015-2017平均）到2020年，碳排放强度从**0.8**降低到**0.5**tCO_{2e}/t
- (方法学正在进一步修订中，2021年底会有更新数据，Further adjustment of the MRV methodology will be republished by 2021）

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China Integrated Waste Management NAMA
中国城市生活垃圾领域国家适当减缓行动项目

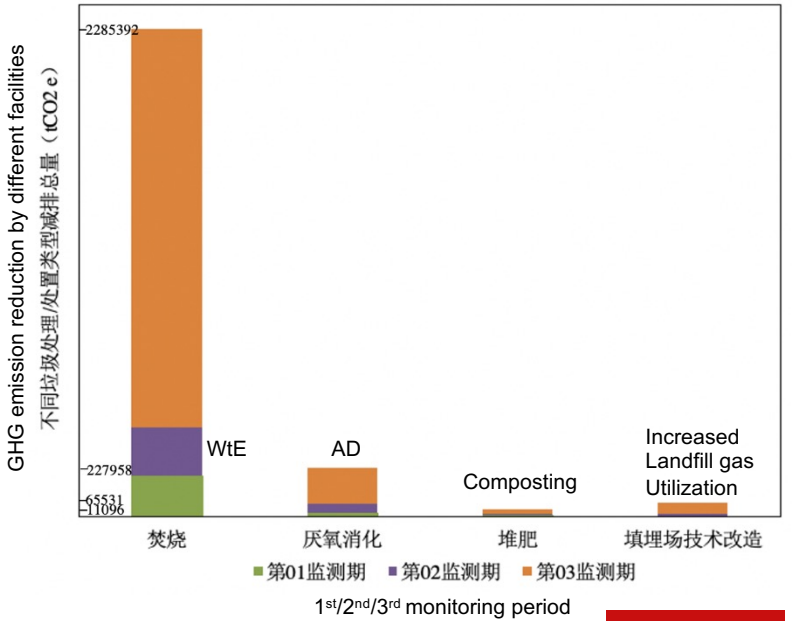
China Integrated Waste Management NAMA

PC3. Analysis of GHG Mitigation Effects
温室气体减排潜力分析

Contribution of different facilities不同处理方式减排贡献

- Compared with the baseline, In the year of 2019 and 2020, the transition from mixed MSW landfill to incineration contributes about 88% of the GHG emission reduction, and kitchen waste AD contributes about 9% ;
- 与基线相比（2015-2017平均），2019及2020年，**88%的减排量来自于混合垃圾由填埋转向焚烧**，9%来源于厨余餐厨垃圾厌氧消化；

- CH4 emission from landfill gas is significant emission source of MSW sector. The material flow of kitchen waste from landfill to incineration or AD plant, can greatly reduce the GHG emission
- 填埋气的无组织释放是垃圾管理碳排放的重要来源；厨余垃圾从填埋场向焚烧/厌氧消化设施的转型，具有重要的意义。



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PC3. Analysis of GHG Mitigation Effects
温室气体减排潜力分析

Challenges faced by the incineration plant 焚烧厂面临的挑战

- The transfer from landfill to incineration of kitchen waste, contributes for the GHG emission reduction of the incineration plants
- 厨余垃圾从填埋到焚烧，为焚烧设施贡献了显著的减排量;

- With the promotion of waste segregation, kitchen waste treatment will contribute more on the GHG emission reduction, incineration plant facing the possibility of increasing GHG emission density。
- 随着垃圾分类推进，减排效益从焚烧厂逐渐转移至厨余垃圾处理设施，焚烧厂排放强度可能较混合垃圾处理时增加。

PC3. Analysis of GHG Mitigation Effects
温室气体减排潜力分析

Challenges faced by the incineration plant 焚烧厂面临的挑战

- Plastic waste increased by 6%, with the heat value increased by 20%
- 塑料组分增加6%，热值相应增加20%

- The increasing of the plastics increased the emission of the incineration，Savings from electricity recovery can not cover the loads from burning fossil carbon；
- 焚烧厂发电的碳减排，不足以抵消塑料等燃烧的化石碳排放;

- With the cleaner background energy, the emission reduction of the energy recovery will be further influenced.
- 另外，背景能源更清洁，焚烧厂减排效益会进一步受到影响

年份	纸类 Paper	塑料 Plastic	木竹 Wood	纤维 Fiber	厨余 Food waste	果蔬 Fruit	金属 Metal	其他 Other	含水率 Moisture	热值 Heat Value
2015~2017	11.60	18.41	0.97	3.60	60.62	2.72	1.23	0.86	62.1%	5300 kJ/kg
2018~2019	10.50	24.30	0.93	6.12	53.40	2.35	0.87	1.51	57.4%	6600 kJ/kg

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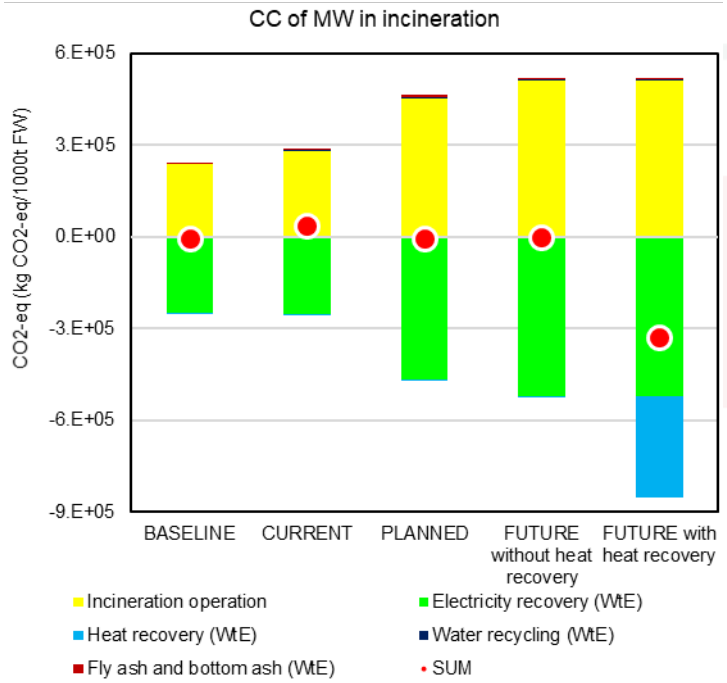
PC3. Analysis of GHG Mitigation Effects
温室气体减排潜力分析



Challenges faced by the incineration plant 焚烧厂面临的挑战

- Under the Carbon Peak and Carbon Neutrality Strategy, to further improve the energy efficiency will be the key point for the incineration plant, the heat utilization should be further considered;
- 双碳战略下，焚烧厂能效优化将会是工作重点，考虑供热的可能性；
- Take one of the incineration plant in demo cities, to improve the energy recovery rate from 25.8% to 28% can keep the carbon footprint in balance.
- 以试点城市中的一个焚烧设施为例，如果能效由25.8%提升至28%，则仍能实现碳排放的平衡；
- Reduce the plastic into the incineration should also be important
- 降低进入焚烧厂的塑料含量也将是一个重要的选择

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PC3. Analysis of GHG Mitigation Effects
温室气体减排潜力分析

Future development of kitchen waste treatment

- Utilization of solid residues is also important besides the biogas utilization
- 除了沼气利用外，沼渣的资源化也非常重要
- Energy consumption and biogas leakage in AD are significant contributors
- 设施管理很重要，设备能耗、沼气泄漏对碳排放影响显著
- Drying process for small composting consumes huge energy and leads to huge loads
- 小型原位烘干设施电耗达280kWh/t，碳排放明显。

GHG emission density of AD plants
垃圾厌氧消化排放强度（tCO_2e/t）

厨余垃圾的厌氧处理必须关注沼渣的资源化，厌氧和堆肥的运维管理水平需要进一步提升
Resource or energy recovery from solid residues is necessary, and AD and composting both need optimization

Debates on what is the best practice, especially on organic waste, if the digestate can not be used in land, the comparation of AD/composting and incineration?
关于最佳实践的讨论，尤其针对厨余垃圾，如果沼渣不能实现土地利用，那么如何比较焚烧和厌氧消化/堆肥的绩效？

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中国城市生活垃圾领域国家适当减缓行动项目

The key points for organic waste treatment

- **High quality segregation**
- **Ensure biogas utilization efficiency**
- **Avoid methane leakage**
- **Promote digestate utilization**

厨余垃圾处理需要关注的重点

- **源头高质量分类**
- **确保沼气的高效利用**
- **加强管理避免沼气泄露**
- **推动沼渣土地利用**

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With the Carbon Neutrality, the development strategy
碳中和背景下的发展趋势

Waste Segregation
垃圾分类

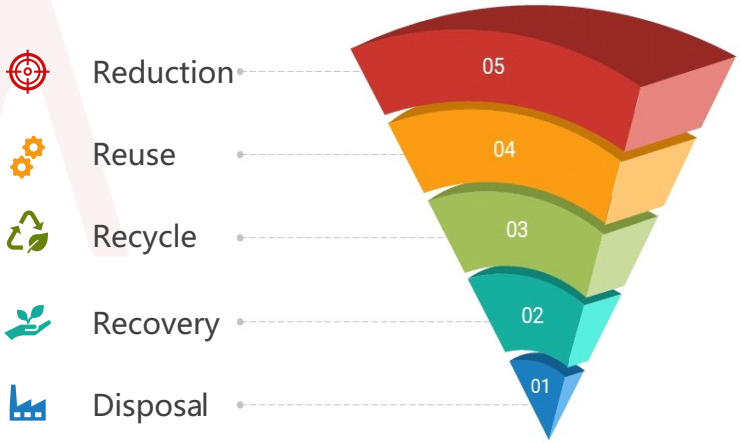
- Zero landfill of the mixed raw waste
- 混合垃圾零填埋

Waste composition
垃圾组分变化

- WtE further improve the energy recovery efficiency
- 焚烧厂进一步提高能源利用效率；
- Recycling especially plastics should be strengthened
- 回收（尤其是塑料回收）需要进一步加强

Energy structure
能源结构变化

- The utilization of digestate should be encouraged
- 有条件的案例下鼓励沼渣的土地利用



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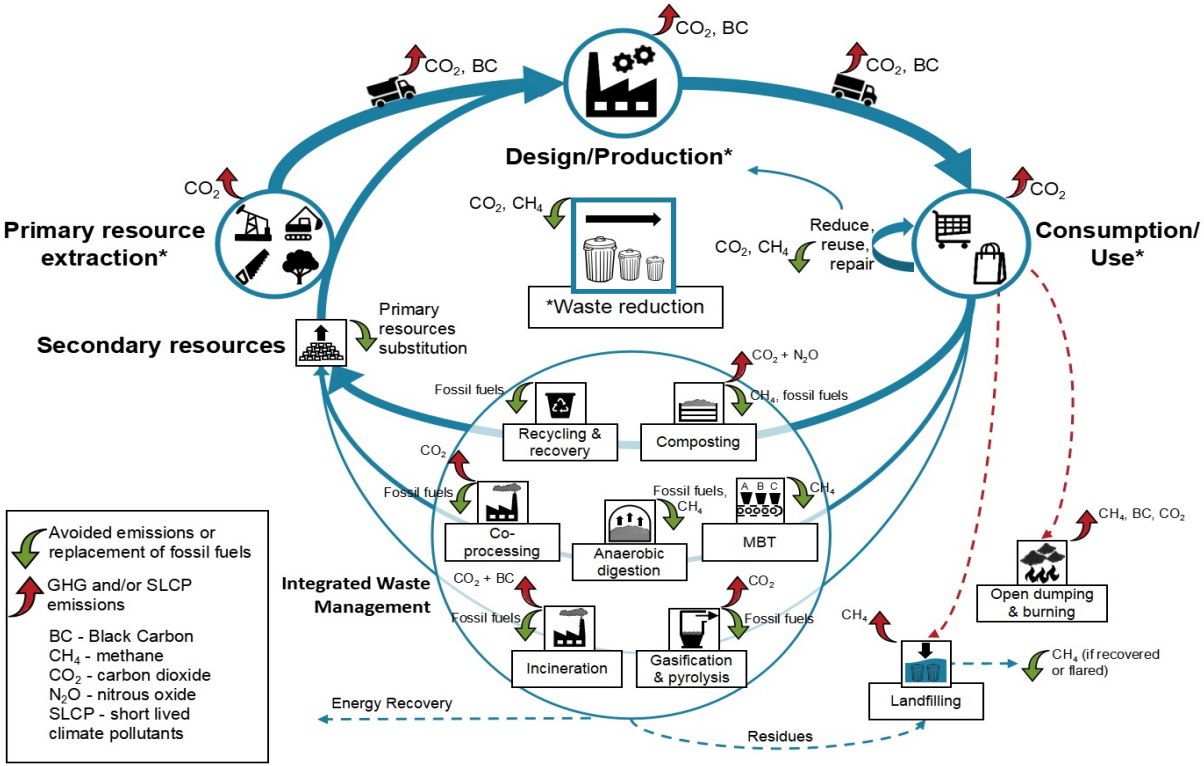
- **协同 Integration**
- **系统 System**
- **价值 Value**



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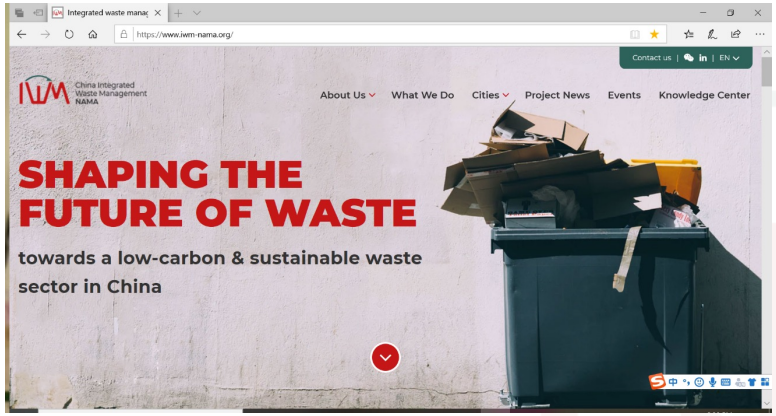

IWM NAMA 官方网站 (iwm-nama.org)

- 6,203 visits had been collected since the launch of the website, generating 19,068 pageviews in total.
- Total 1909 downloads of the outputs

微信公众号(GIZ-IWMNAMA)

- The total follower number hit to 1881
- 64,916 readerships generated in total

TOP 1: Financial Instrument and Business Model of Waste Management

TOP 2: Reports on Waste Segregation of GIZ Office in China

TOP 3: [Knowledge Sharing] Quality Assurance of Compost and Digestate

中国城市生活垃圾领域国家适当减缓行动项目
China Integrated Waste Management NAMA

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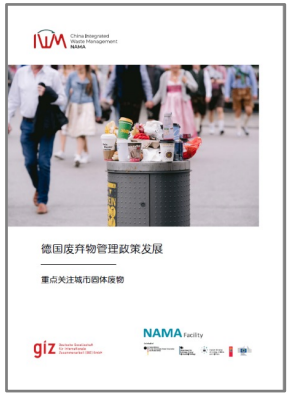

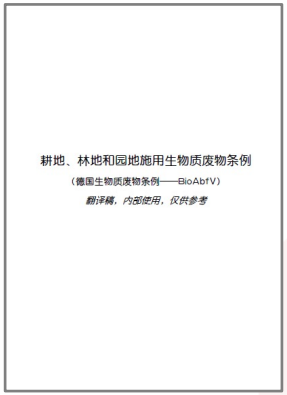

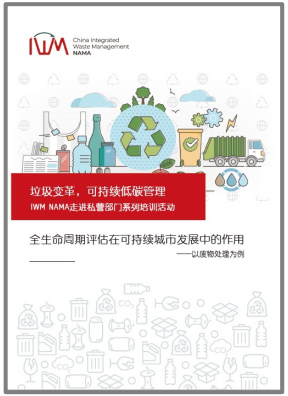

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