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- ✓ 主要研究方向为生活垃圾分类处理技术与管理体系、固体废物资源化/建材化利用技术、含重金属/毒性有机物危险废物新型处置技术等。
- ✓ 主持国家重点研发计划、科技支撑计划、“863”计划、自然科学基金等多项重要研究课题
- ✓ 兼任国际固体废物工作组织（IWWG）科学咨询组成员、“生物质与废物资源化国际会议”共同主席，住建部科学技术委员会城市环境卫生专委会委员，住建部市容环境卫生行业技术标准委员会委员，中国环保产业协会理事、中国城市环境卫生协会专家、中国循环经济协会专家、《环境卫生工程》副主编等职。

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- The main research directions are domestic waste classification and treatment technology and management system, solid waste energy/building materials utilization technology, etc.
- Presided over a number of important research topics such as the National Key R&D Program, Science and Technology Support Program, "863" Program, Natural Science Foundation, etc.
- He is also a member of the Scientific Advisory Group of the International Solid Waste Working Group (IWWG), co-chair of the "International Conference on Biomass and Waste Energy Conversion", a member of the Urban Environmental Sanitation Special Committee of the Science and Technology Committee of the Ministry of Housing and Urban-Rural Development, and a member of the Urban Appearance and Environmental Sanitation Industry Technical Standardization Committee of the Ministry of Housing and Urban-Rural Development, Director of China Environmental Protection Industry Association, Expert of China Urban Environmental Sanitation Association, Deputy Editor-in-Chief of "Environmental Sanitation Engineering", etc.

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我国生活垃圾分类发展前景展望

Opportunities for Improved Municipal Solid Waste Segregation in BTH and the People' s Republic of China – Q&A

汇报人：刘建国
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全新形势：分类、无废、限塑、双碳成为国家战略

New situation: classification, zero waste, plastic restriction and carbon emission reduction become national strategy

- 习近平总书记高度重视、亲自部署、着力推动垃圾分类工作，多次作出重要指示批示。
- 2016年12月中央财经领导小组第十四次会议提出“普遍推行垃圾分类制度”。
- 2017年4月中央深改组通过《关于禁止洋垃圾入境推进固体废物进口管理制度改革实施方案》。
- 2018年12月中央深改委通过《“无废城市”建设试点工作方案》。
- 2019年9月中央深改委通过《进一步加强塑料污染治理的意见》。
- President Xi attaches great importance to, personally arranges and promotes the work of MSW classification, and has made important instructions for many times.
- In December 2016, the 14th meeting of the Central Leading Group for Financial and Economic Affairs put forward the "universal implementation of garbage classification system".
- In April 2017, the Central Committee of the Communist Party of China (CPC) adopted the Implementation Plan for Banning Foreign Waste from Entering China and promoting the Reform of the Solid Waste Import Management System.
- In December 2018, the CPC Central Committee for Deep Reform approved the Pilot Work Plan for the construction of "Zero-Waste Cities".
- In 2019, the Commission for Deep Reform of the CPC Central Committee adopted the Opinions on Further Strengthening the treatment of plastic Pollution.

全新形势：分类、无废、限塑、双碳成为国家战略

New situation: classification, zero waste, plastic restriction and carbon emission reduction become national strategy

- 2020年9月中央深改委通过《关于进一步推进生活垃圾分类工作的若干意见》。
- 2020年9月实施的《固体废物污染环境防治法》总则明确“国家推行生活垃圾分类制度”。
- 北京市（2020.5.1）、天津市（2020.12.1）、河北省（2021.1.1）生活垃圾管理地方性法规相继出台。
- 《反食品浪费法》已经颁布，《资源综合利用法》进入立法程序。
- 中国向全世界作出庄严承诺，2030实现碳达峰，2060实现碳中和。
- In September 2020, the CPC Central Committee adopted the Opinions on Further Promoting MSW Classification.
- The General provisions of the Law on the Prevention and Control of Environmental Pollution by Solid Waste, which came into effect in September 2020, specify that "the state implements a municipal solid waste classification system".
- Local laws and regulations on MSW classification in Beijing(05/01/2020),Tianjin(12/01/2020) and Hebei Province provinces(01/01/2021) have been promulgated intensively.
- Anti food waste law of China has been enacted and the Comprehensive Utilization of Resources Act has entered the legislative process.
- China has made a solemn commitment to the world to achieve carbon peak by 2030 and carbon neutral by 2060.

全新形势：生态文明社会文明社会治理抓手属性日益凸显

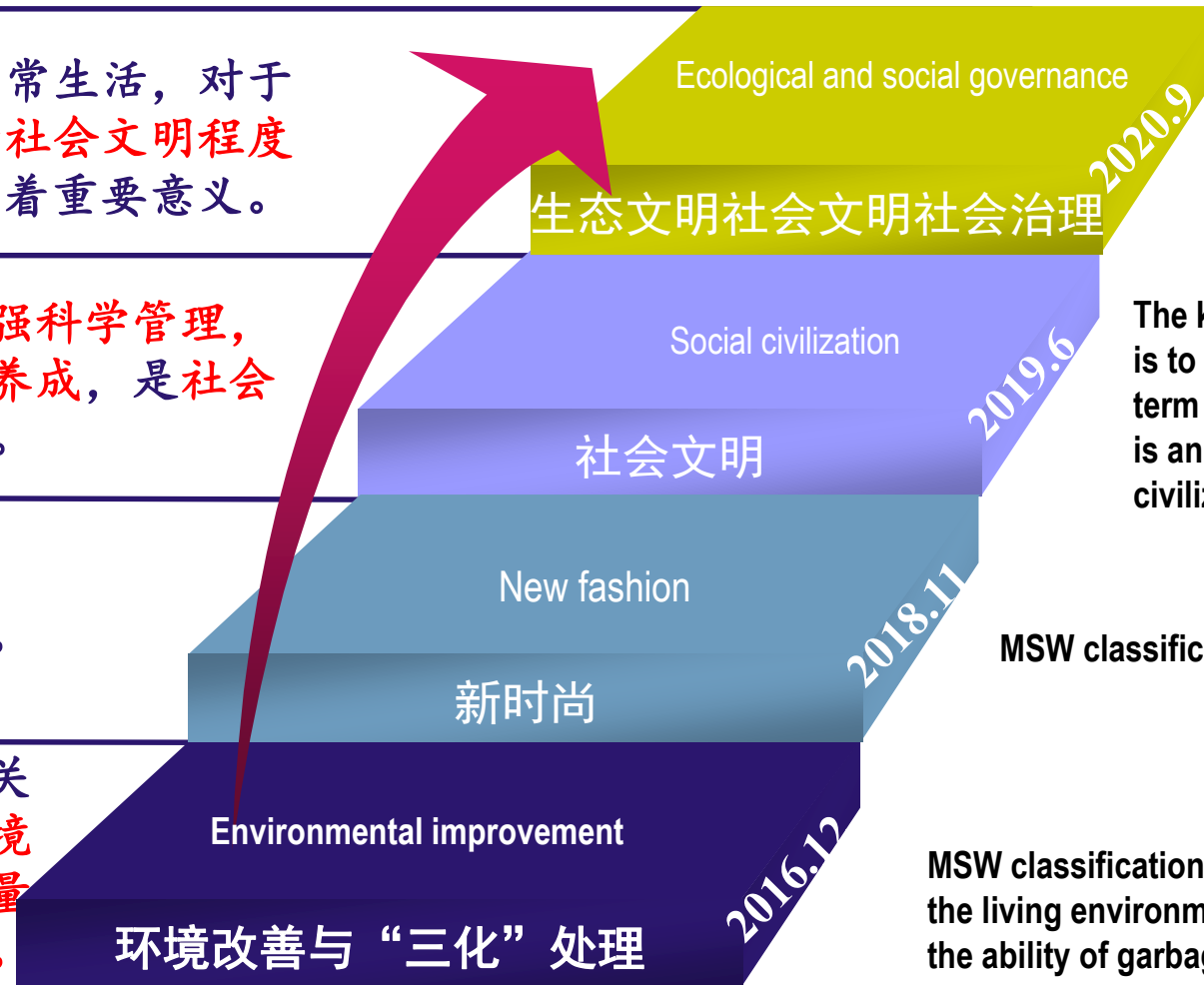
New situation: ecological civilization and social civilization are increasingly prominent

垃圾分类关系人民群众日常生活，对于推动生态文明建设、提升社会文明程度、创新基层社会治理都有着重要意义。

实行垃圾分类关键是要加强科学管理，形成长效机制，推动习惯养成，是社会文明水平的一个重要体现。

垃圾分类工作就是新时尚。

普遍推行垃圾分类制度，关系十三亿多人生活环境改善，关系垃圾能不能减量化、资源化、无害化处理。



MSW classification has close relationship with daily life of people and is of great significance to the construction of ecological civilization, the promotion of social civilization and the innovation of the foundation.

The key to the implementation of MSW classification is to strengthen scientific management, form a long-term mechanism and promote habit formation, which is an important embodiment of the level of social civilization.

MSW classification is the new fashion.

MSW classification system has a bearing on the improvement of the living environment of more than 1.3 billion people, and on the ability of garbage to be reduced, reused, and disposed of harmlessly.

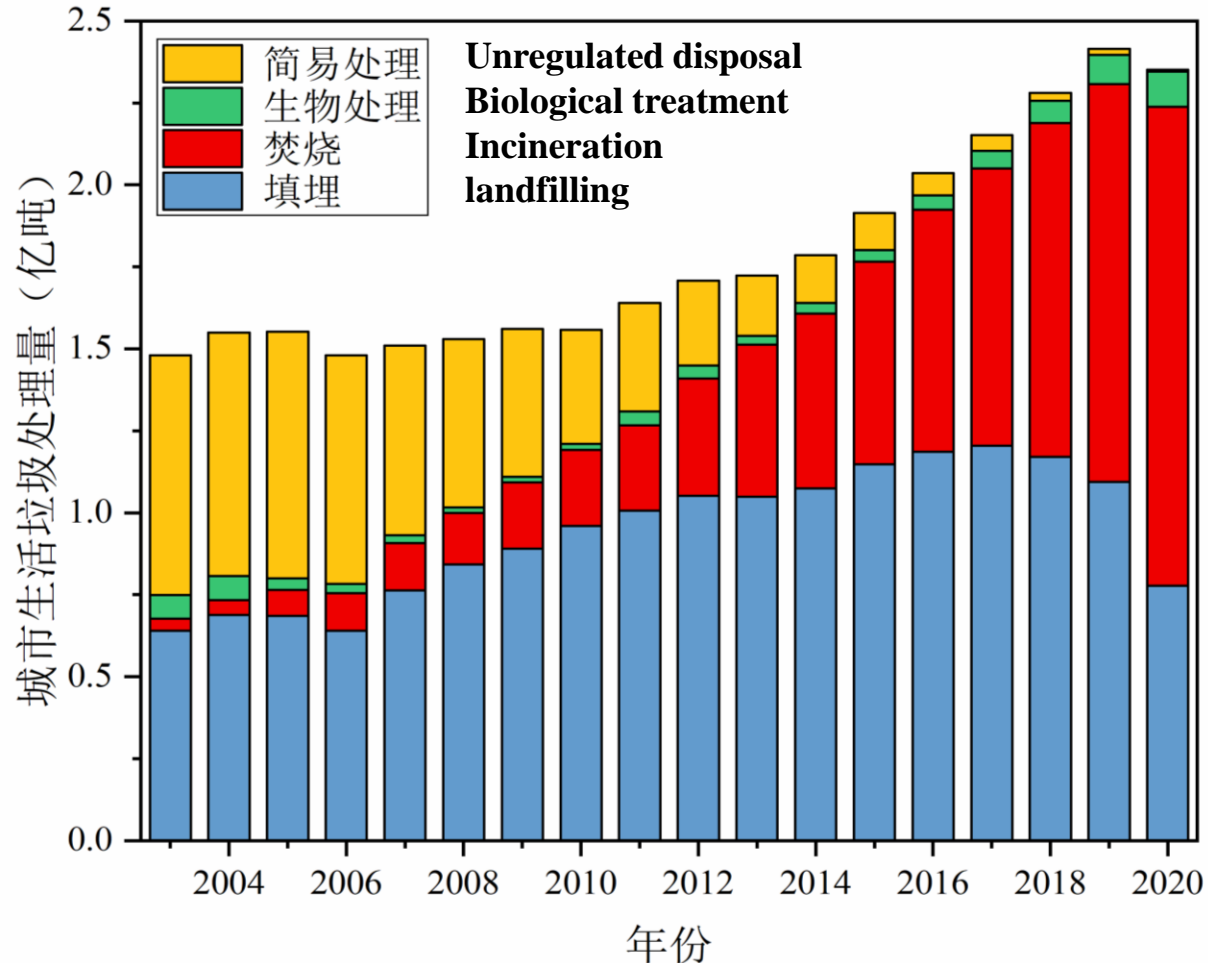
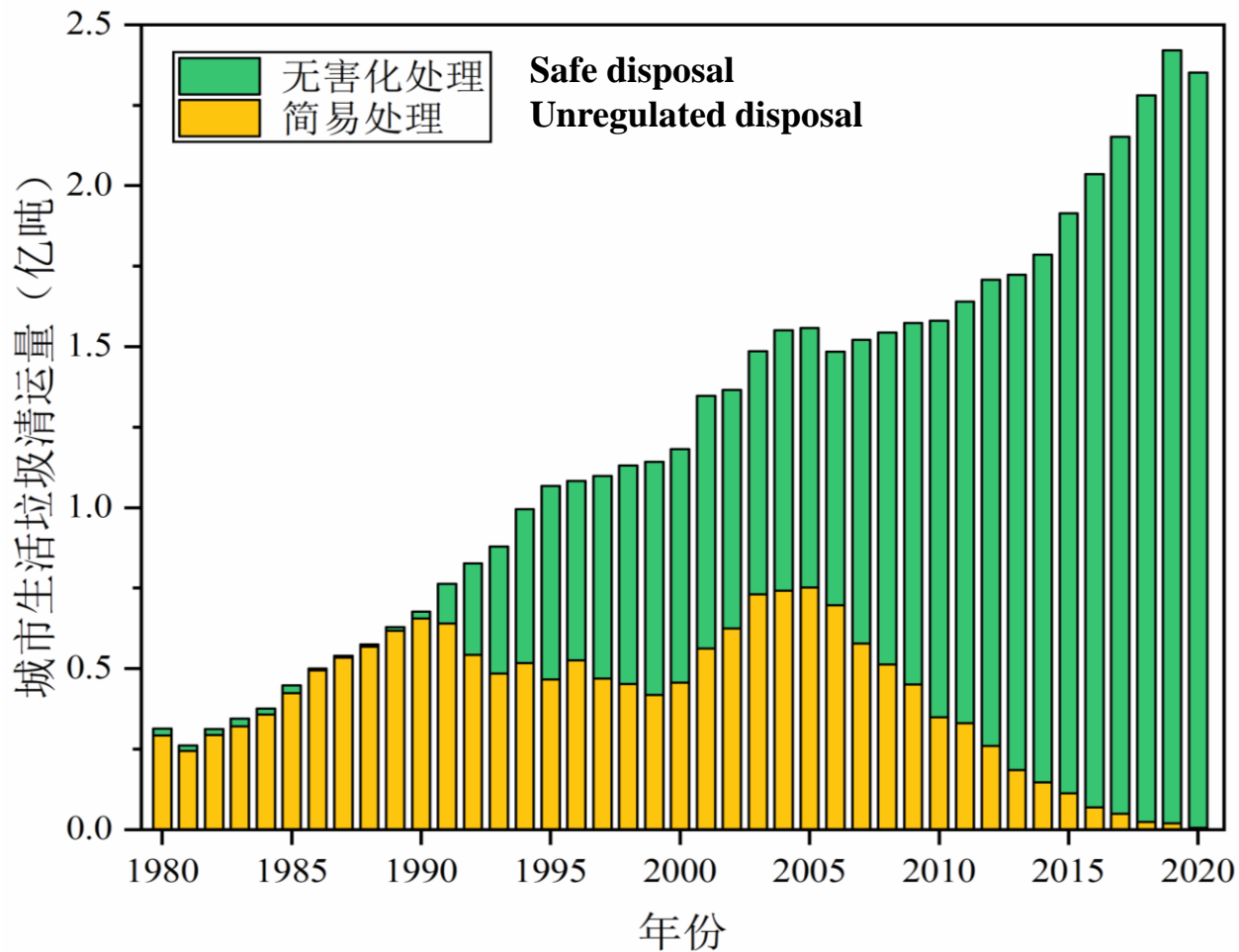
全新形势：多方压力与制约掣肘带来巨大挑战

New situation: multiple pressures and constraints bring great challenges



良好基础：40年来我国生活垃圾处理取得巨大成就

Good base: over the past four years, the waste disposal of our country has made great achievements

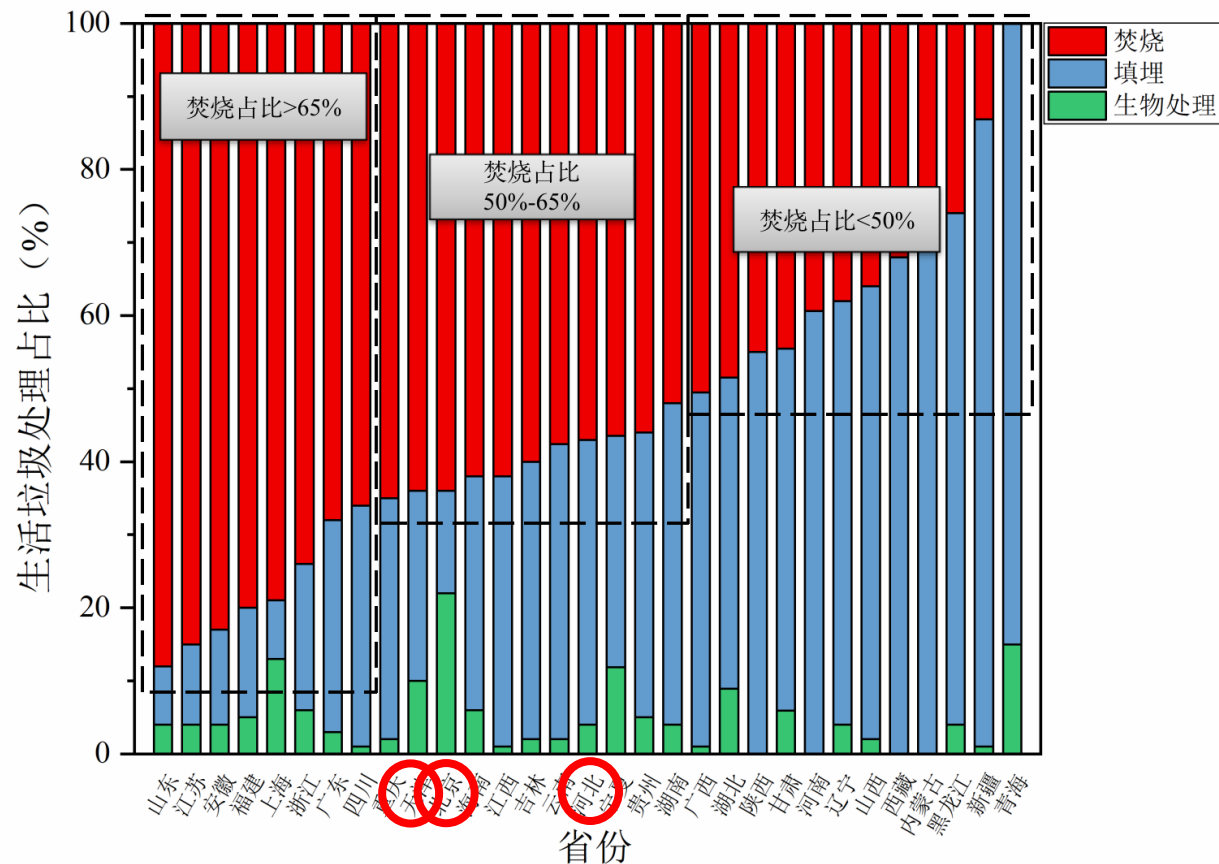
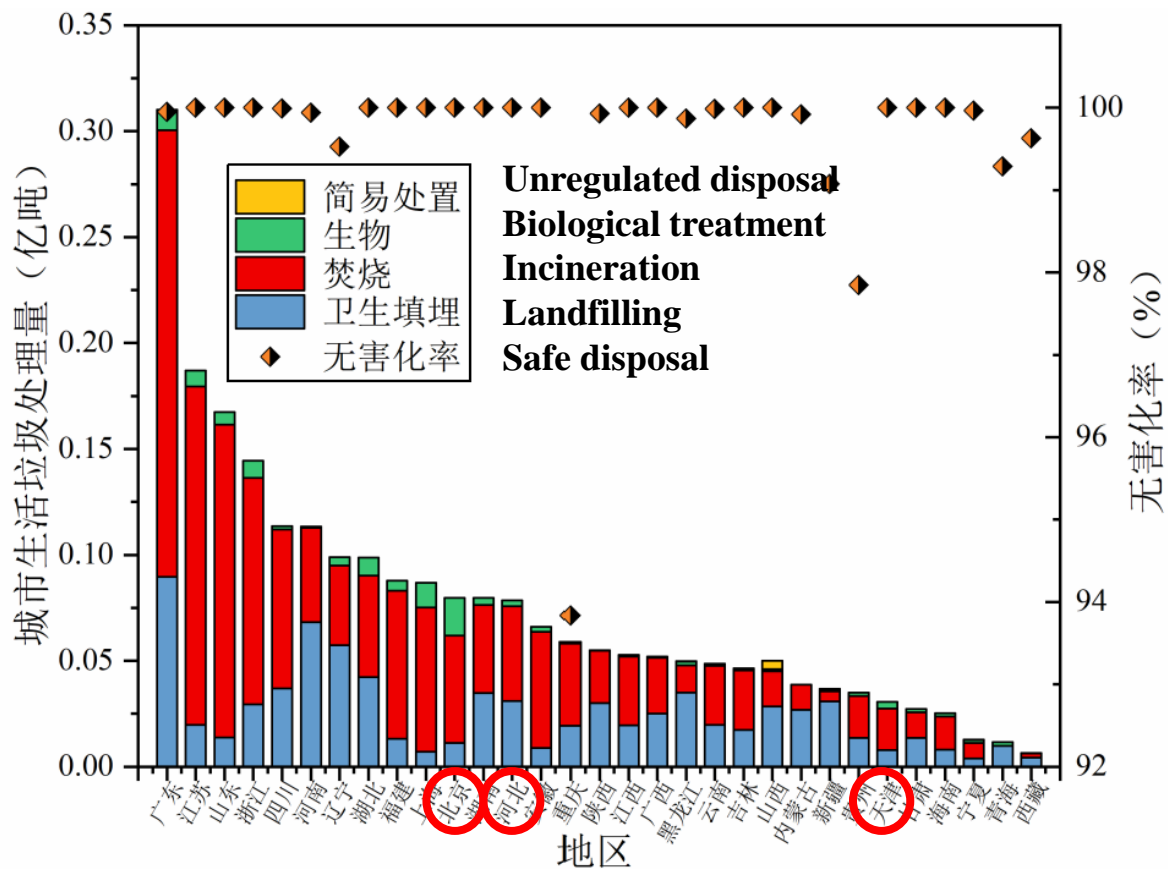


2020年无害化处理率超过99.8%
Safe disposal rate higher than 99.8% in 2020

2020年焚烧占比62.3%，填埋33.1%，其他4.6%
Incineration 62.3%, landfilling 33.1%, and others 4.6% in 2020

良好基础：40年来我国生活垃圾处理取得巨大成就

Good base: over the past four years, the waste disposal of our country has made great achievements



京津冀城市生活垃圾2020年无害化处理率达到100%

Safe disposal 100% in 2020 in Beijing, Tianjin and Hebei

京津冀2020年城市生活垃圾焚烧占比介于50-65%之间，北京市生化处理能力全国领先

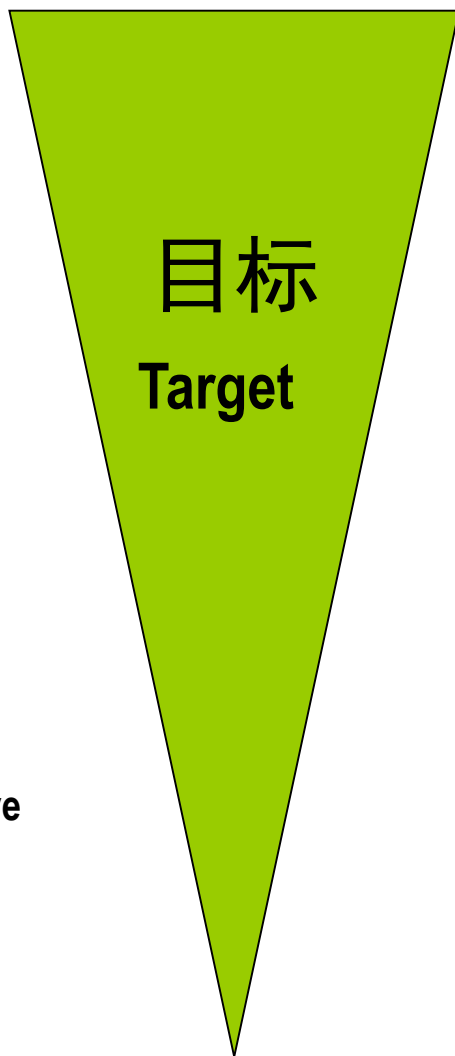
Incineration 50-65% in 2020 in Beijing, Tianjin and Hebei, and biological treatment capacity of Beijing is leading in China.

良好基础：“从量变到质变”的合力逐步加强

Good foundation: the resultant force of "from quantitative change to qualitative change" is gradually strengthened

新型模式
注重质的
提升，分
类成为必
然要求

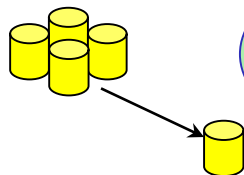
New pattern pays
attention to qualitative
promotion,
classification
becomes inevitable
requirement



Source avoidance and reduction

源头避免与减量

绿色生产
绿色生活
绿色消费
源头分类



清洁生产 Cleaner production
绿色生产 Green production

资源回收 Resource recovery

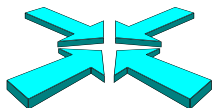
循环使用
再生利用
回收利用
土地利用



循环经济 The circular economy
城市矿产 Urban mineral
产业共生 Industrial symbiosis

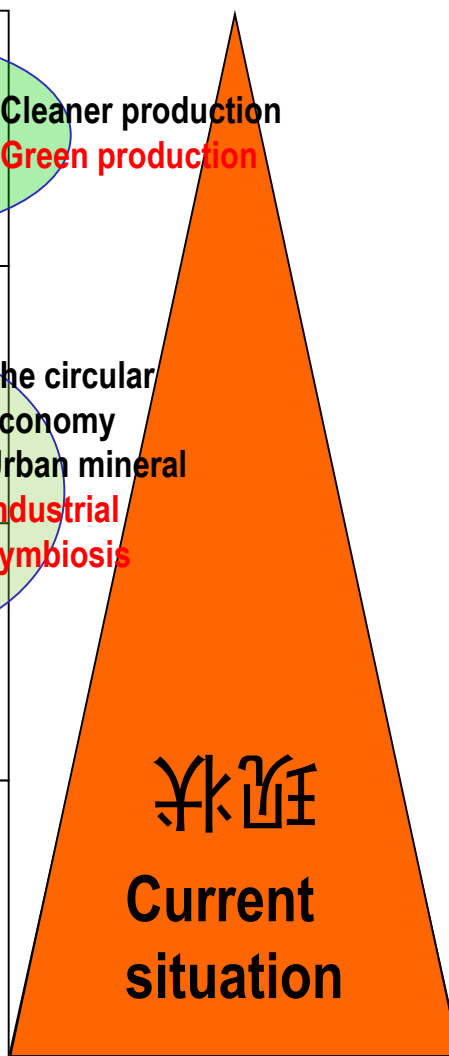
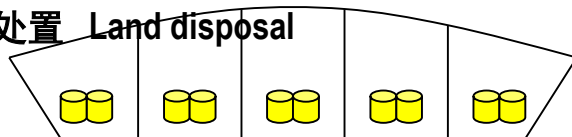
能源回收 Energy recovery

机械处理
物化处理
生化处理
热处理（焚烧发电、协同焚烧）



最终处置 The final disposal

填埋 Landfill
土地处置 Land disposal

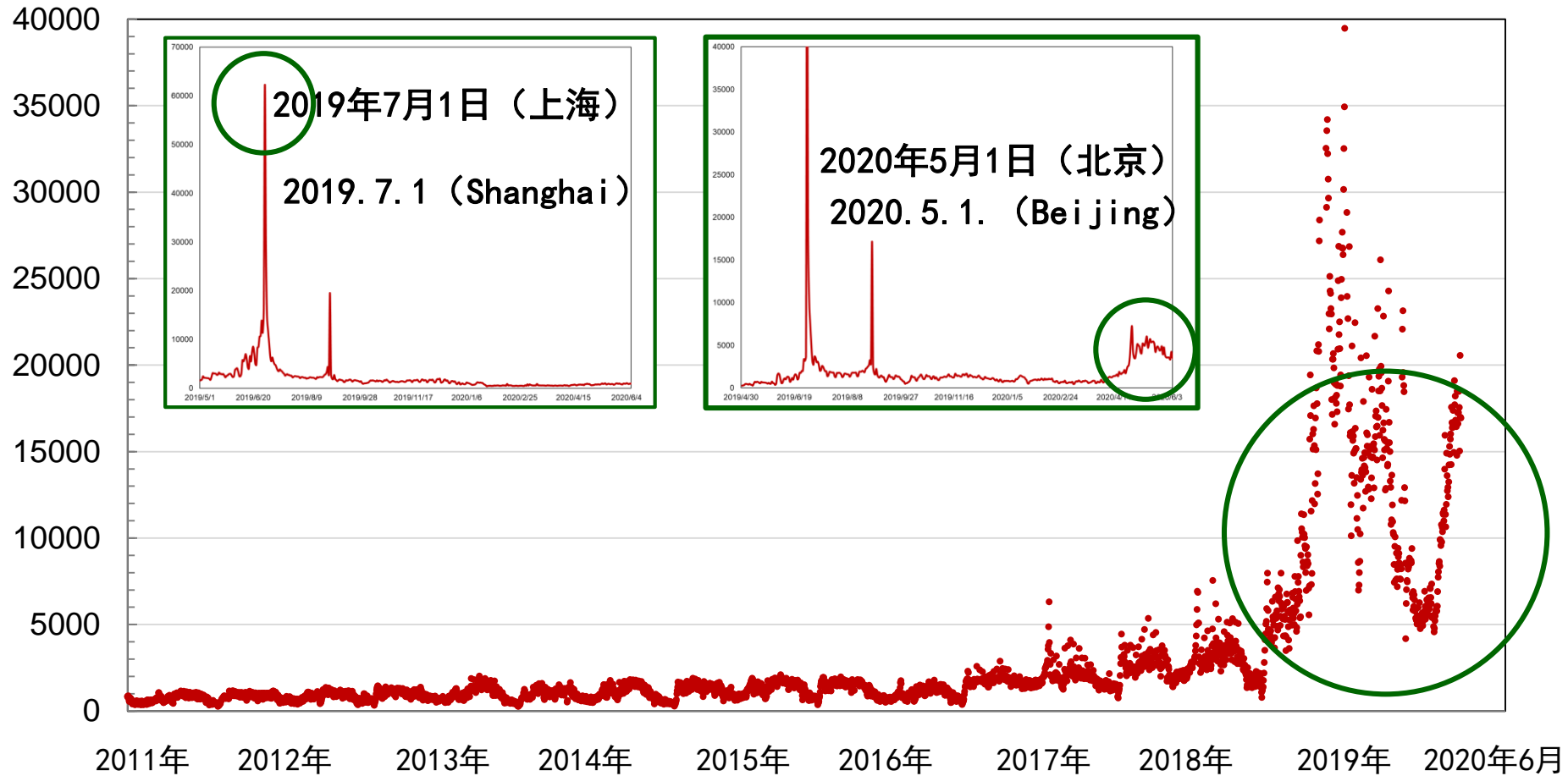


传统模式
依赖量的
扩张，潜
力已经挖
掘殆尽

Traditional model
depends on the
expansion of quantity,
and potential has
been tapped out

良好基础：全民参与的良好文化氛围正在逐步形成

Good foundation: A good cultural atmosphere for the participation of all is gradually forming



“垃圾分类”百度搜索指数近2年呈爆发式增长

Baidu search index of "MSW classification" in the past two years showed explosive growth

系统推进：法治、制度、文化、设施建设多管齐下

Systematic promotion: the rule of law, system, culture, facilities construction

● 政府统筹部门联动制度

● 分类管理责任人制度

● 生产者责任延伸制度

● 差异化收费制度

● 城乡/区域统筹及生态补偿制度

● The linkage system of government departments

● Management system of persons in charge of waste classification

● Extended producer responsibility system

● Differentiated charging system

● Urban and rural/regional integrated management and eco-compensation system



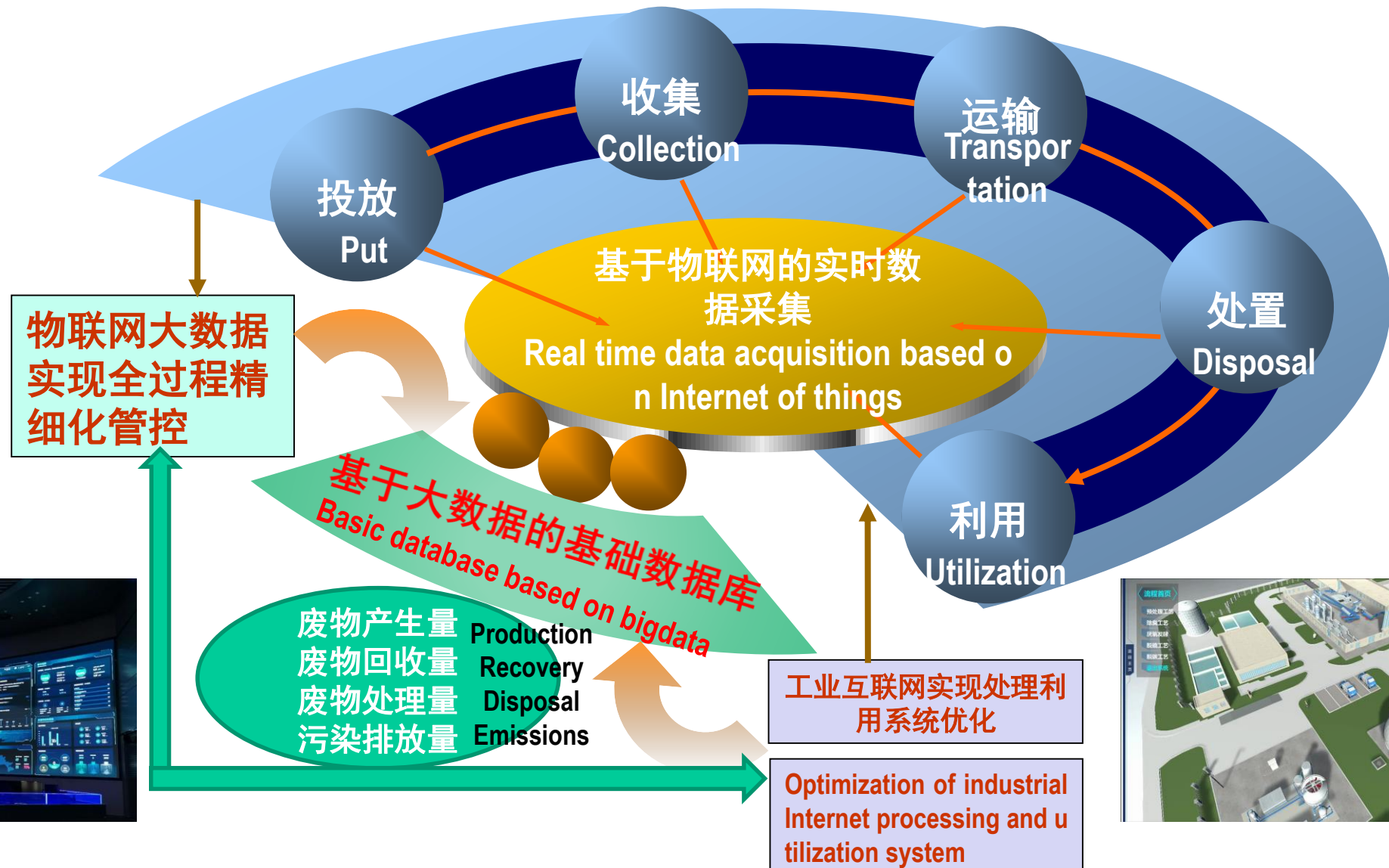
多元共治：社会协同各尽其责，提升社会文明水平

Pluralistic co Governance: social coordination, each performing its own duties and improving the level of social civilization



精细管理：基于信息化手段构建全过程智慧监管平台

Fine management: build a whole process intelligent supervision platform based on information means



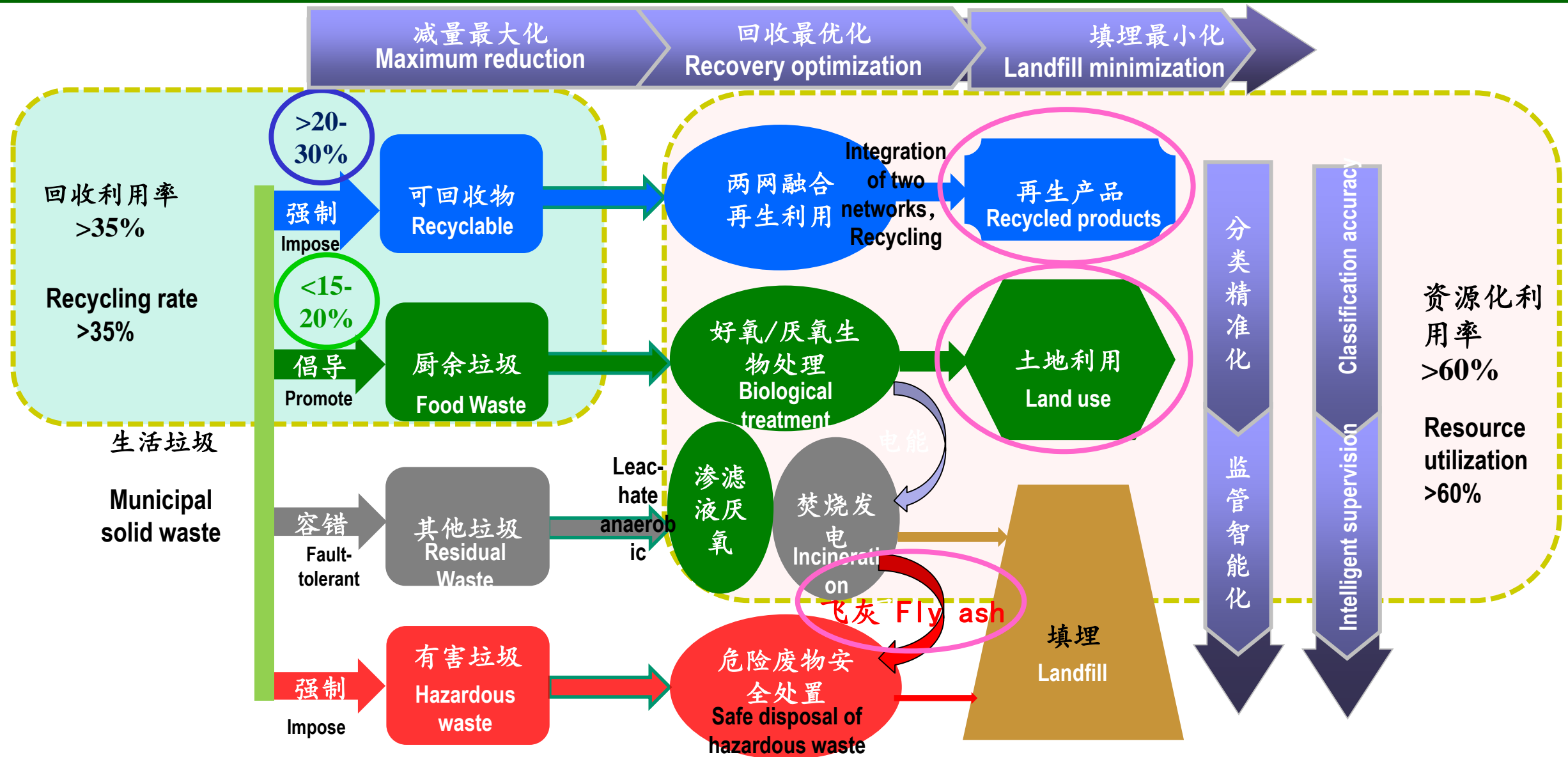
Internet of things big data to achieve fine control of the whole process

物联网大数据实现全过程精细化管理



处理系统：环环相扣一体优化的结构框架

Processing system: an integrated and optimized structural framework



处理系统：“四分类”共同但有区别的功能定位

Processing system: common but differentiated functional positioning of "four classifications"

可回收物强制分类
与规范回收是垃圾
资源化利用的重点
方向

可回收物 强制

厨余垃圾适度分类
与土地利用是处理
系统优化增效的主
要节点

倡导 厨余垃圾

Compulsory classification
and standardized
recycling of recyclable
waste is the key direction
of waste resource
utilization

Recyclable Impose

The proper classification
and land use of kitchen
waste are the main nodes
for the optimization and
efficiency of the treatment
system

Promote Food Waste

其他垃圾 容错

其他垃圾焚烧发电
是大型城市垃圾分
类处理的核心保障
设施

强制 有害垃圾

有害垃圾源头分类
是处理系统环境风
险控制的有效方式

Residual Waste Fault-
tolerant

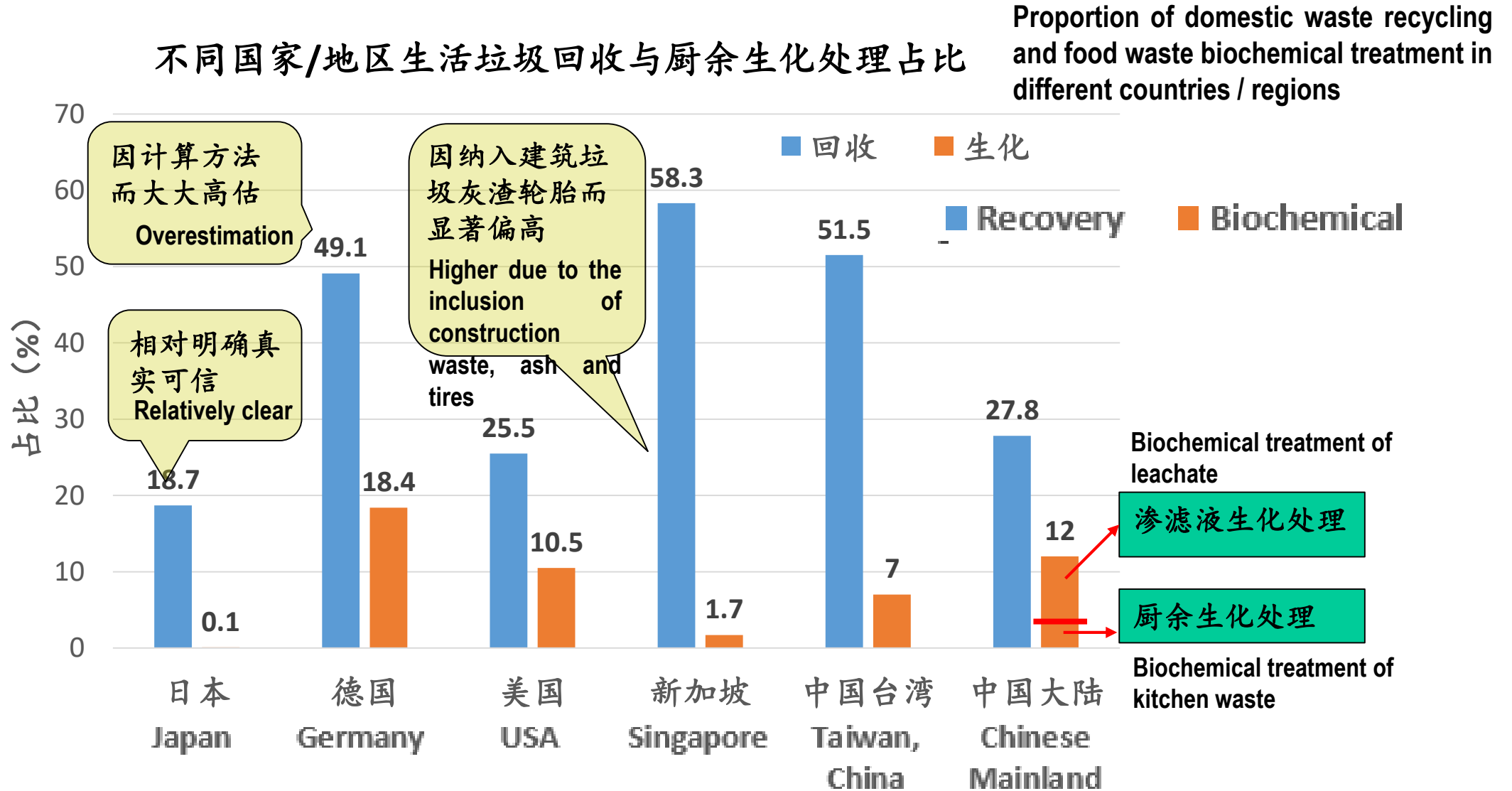
Other waste incineration
power generation is the
core guarantee facility for
waste classification and
treatment in large cities

Impose Hazardous waste

The source classification
of hazardous waste is an
effective way to control
the environmental risk of
the treatment system

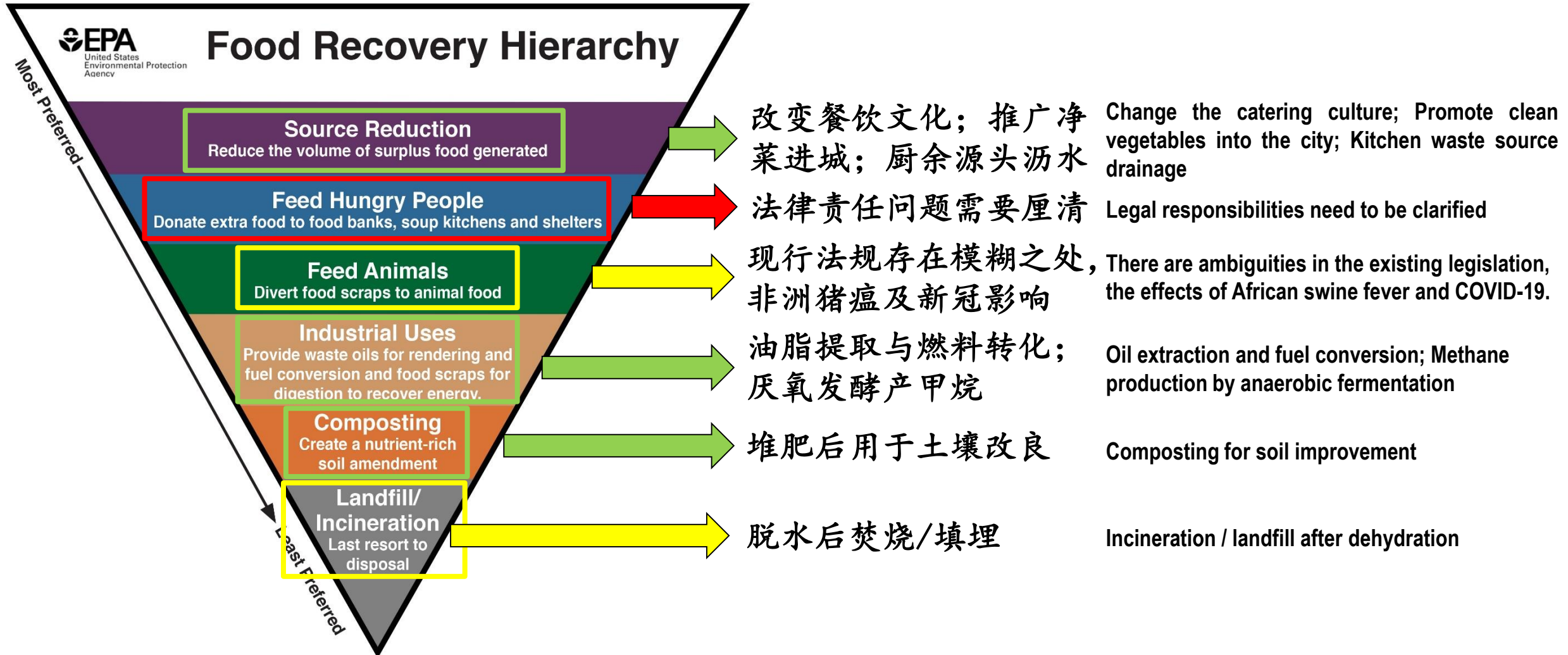
短板弱项：高效率厨余处理，规范化回收利用

Weaknesses: high efficiency kitchen waste treatment and standardized recycling



厨余处理：明确源头减量与分类回收层次架构

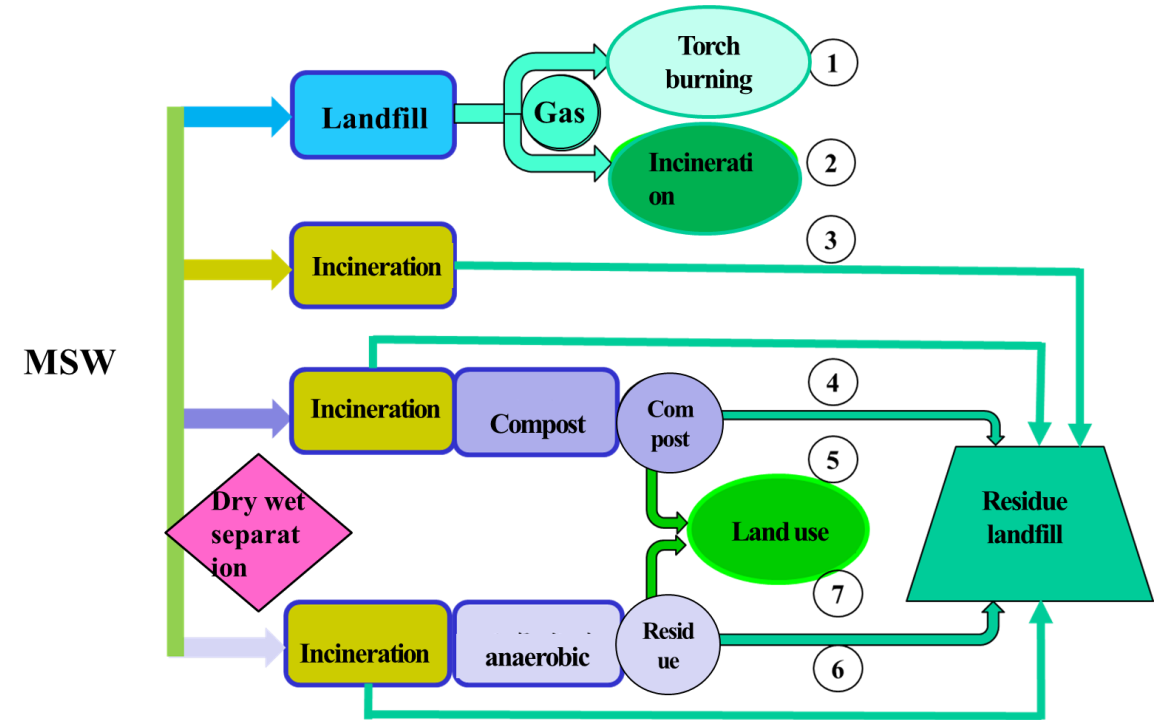
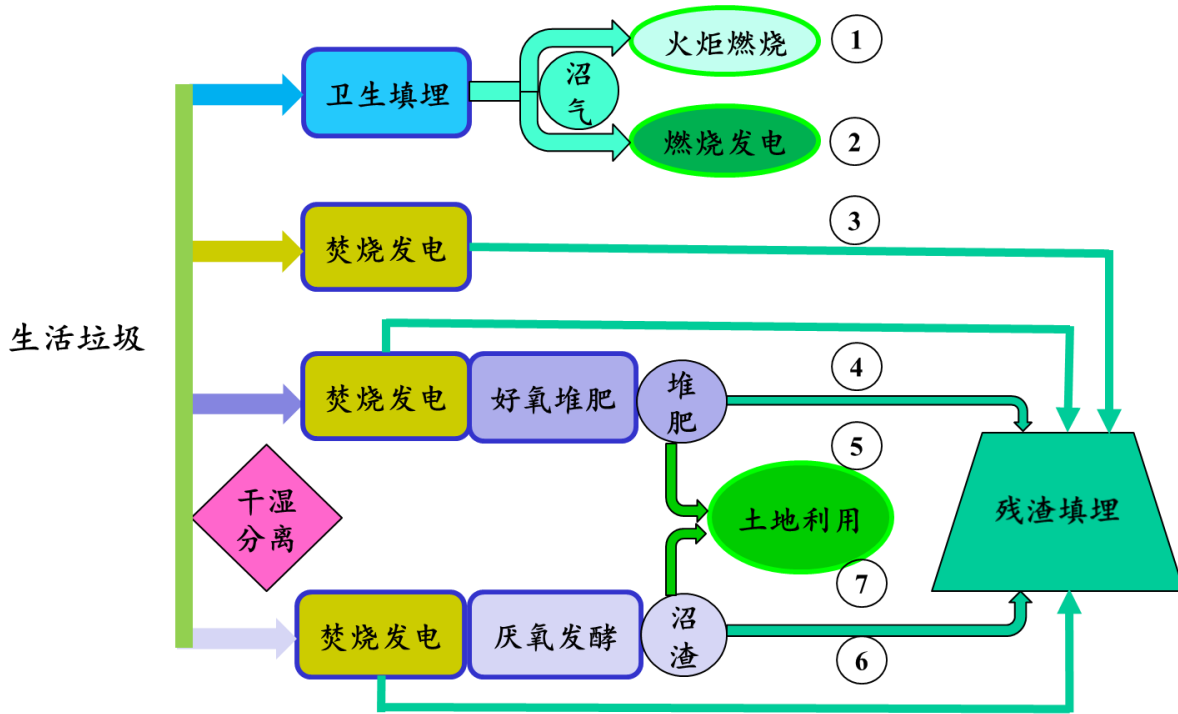
Kitchen waste treatment: clarify the hierarchical structure of source reduction and classified recycling



图片引自USEPA网站

厨余处理：适度适量分类处理，保证实现土地利用

Kitchen waste treatment: appropriate classification treatment to ensure the realization of land use

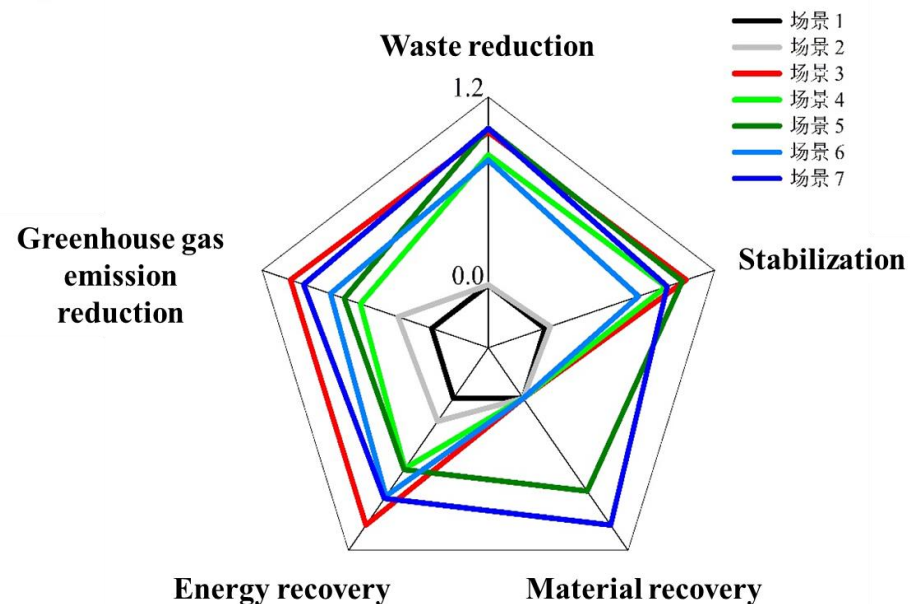
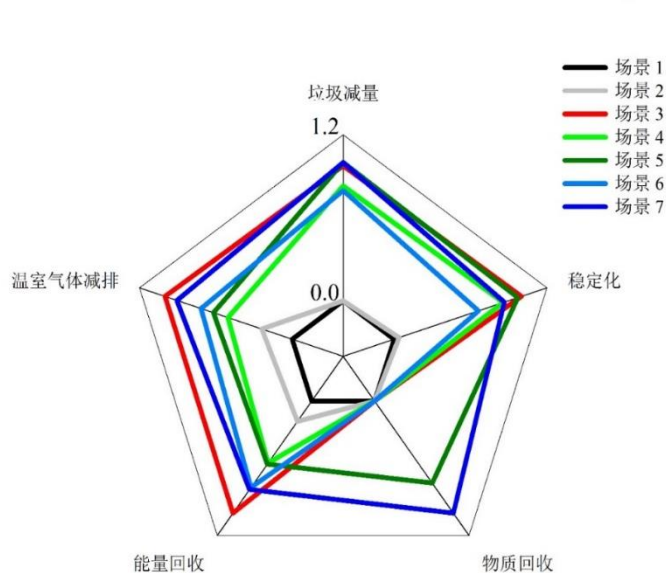
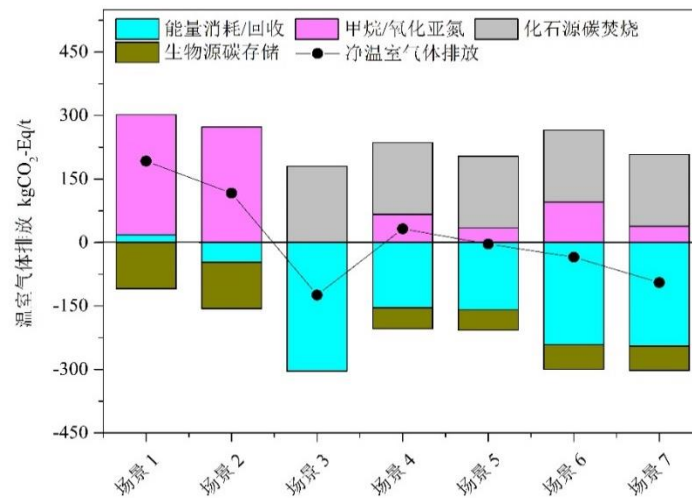


生活垃圾焚烧发电在碳减排及综合环境绩效方面优势明显。干湿分离+焚烧发电+厌氧发酵的优化组合模式是否具有显著**比较优势取决于发酵产物能否实现安全土地利用。**

- MSW incineration power generation has obvious advantages in carbon emission reduction and comprehensive environmental performance.
- The advantages of the optimized combination mode of dry wet separation + incineration power generation + anaerobic fermentation depend on whether the fermentation products can realize safe land use.

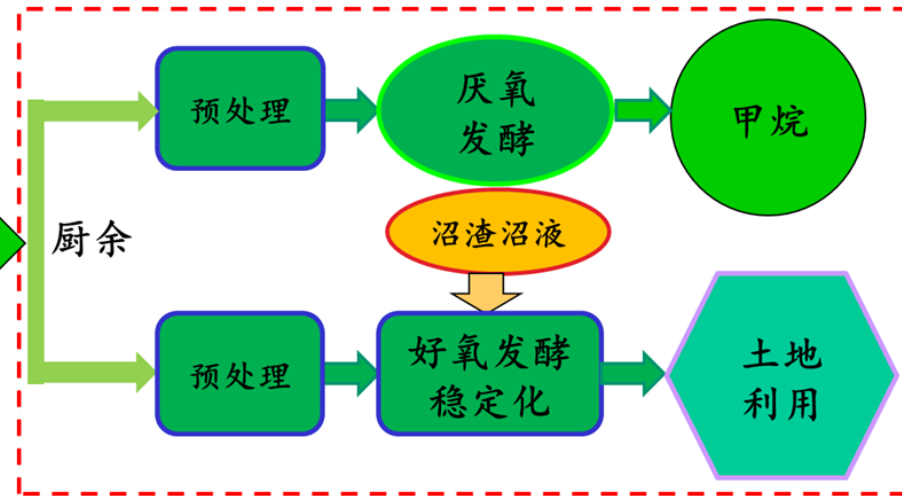
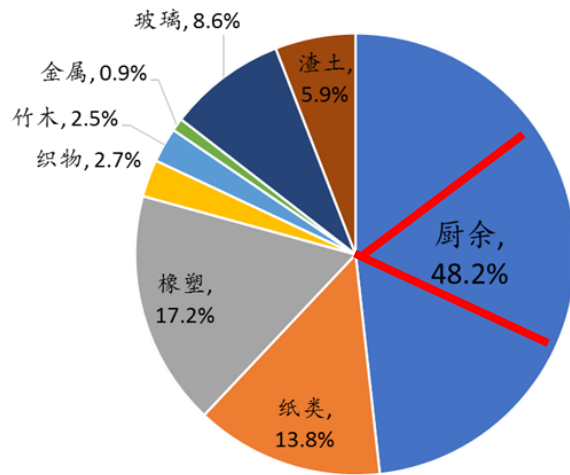
厨余处理：适度适量分类处理，保证实现土地利用

Kitchen waste treatment: appropriate classification treatment to ensure the realization of land use

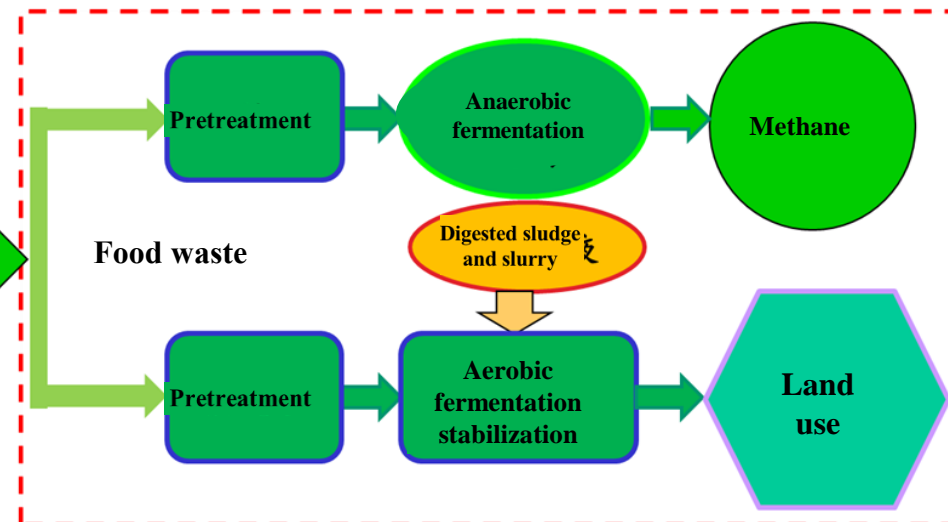
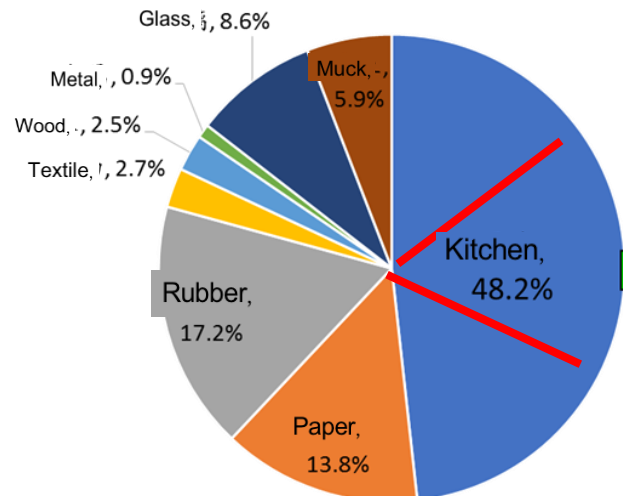


厨余处理：适度适量分类处理，保证实现土地利用

Kitchen Waste Treatment: appropriate classification treatment to ensure the realization of land use



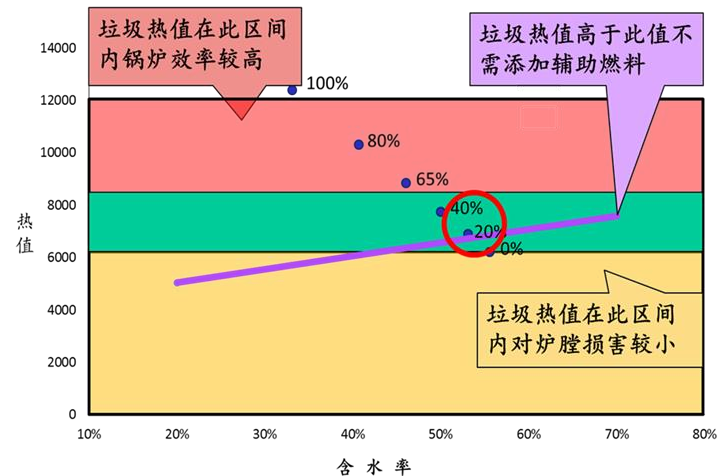
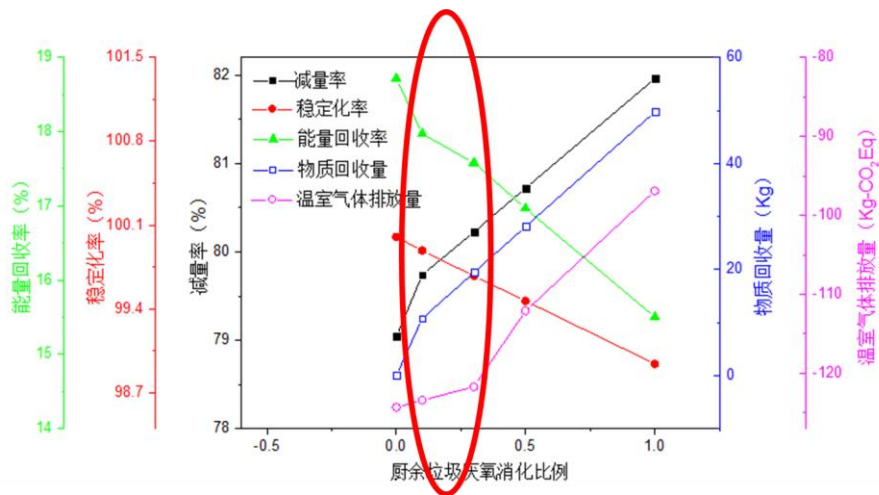
干湿分开，努力方向。
积极鼓励，相得益彰。
定时定点，适度适量。
湿中无干，理所应当。
干中无湿，两败俱伤。



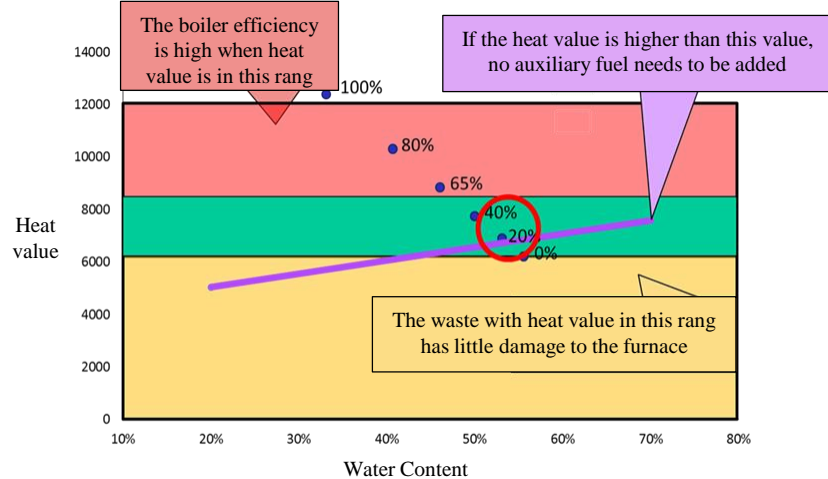
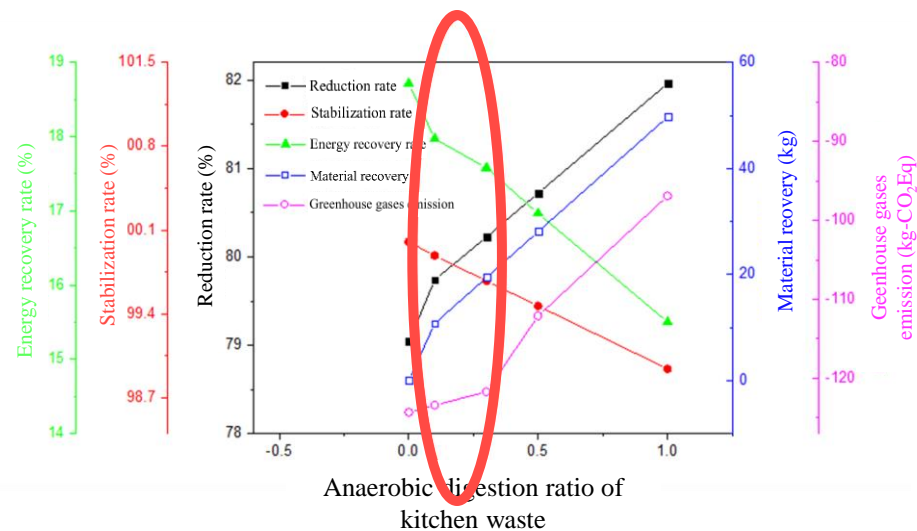
Separate dry and wet, effort direction.
Actively encourage, and complement each other.
Regular and fixed points, moderate and appropriate.
No dry waste in the wet waste, as it should be.
No wet waste in the dry waste, both lose.

厨余处理：适度适量分类处理，保证实现土地利用

Food Waste Treatment: appropriate classification treatment to ensure the realization of land use



厨余垃圾分出约20-40%时，焚烧效率最佳



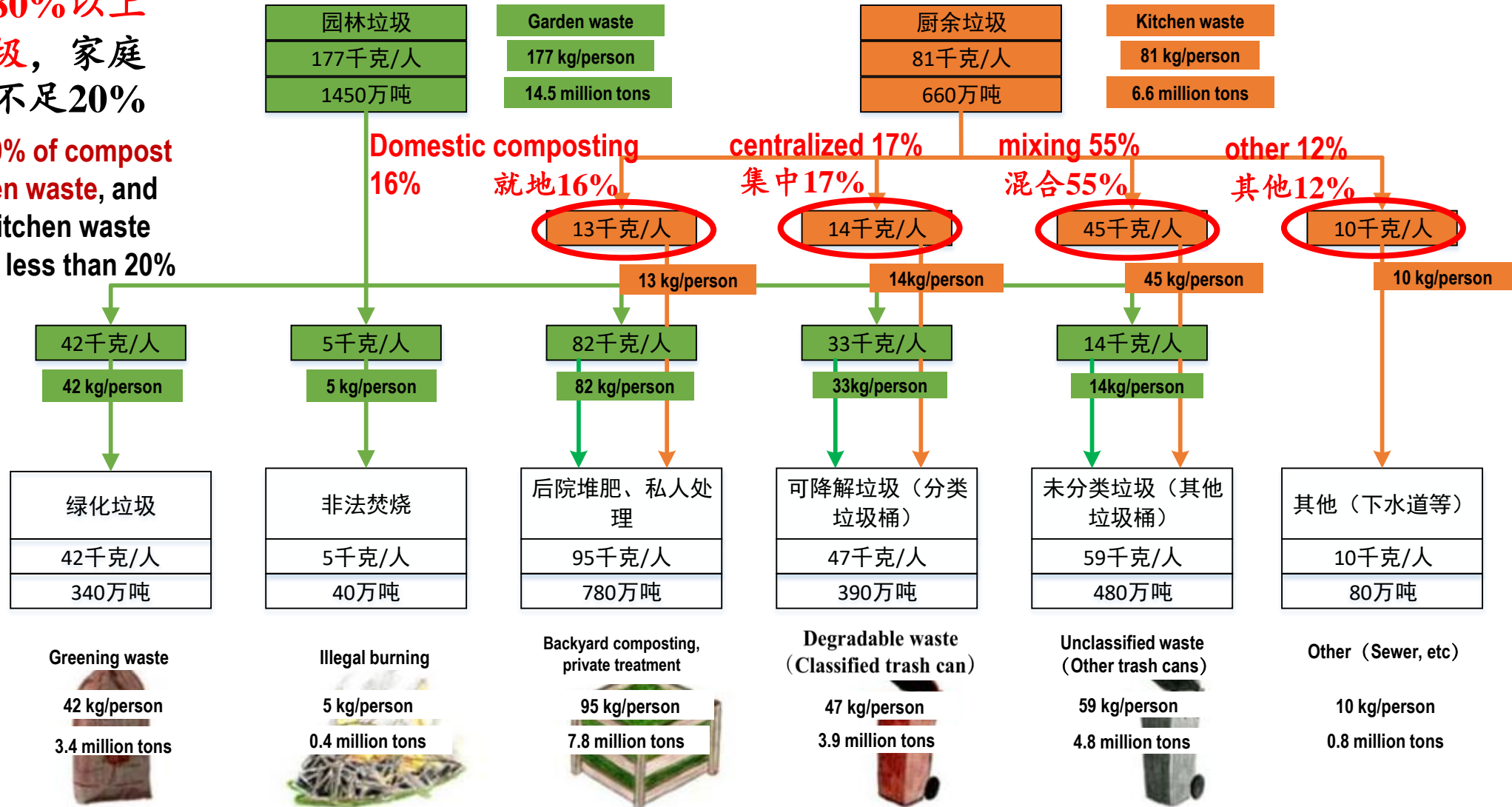
When the food waste is separated out by about 20-40%, the incineration efficiency is the best

厨余处理：集中、就地、混合、粉碎处理相结合

Kitchen Waste Treatment: combination of centralized, in-situ, mixing and crushing treatment

堆肥进料80%以上
为园林垃圾，家庭
厨余占比不足20%

More than 80% of compost
feed is garden waste, and
household kitchen waste
accounts for less than 20%

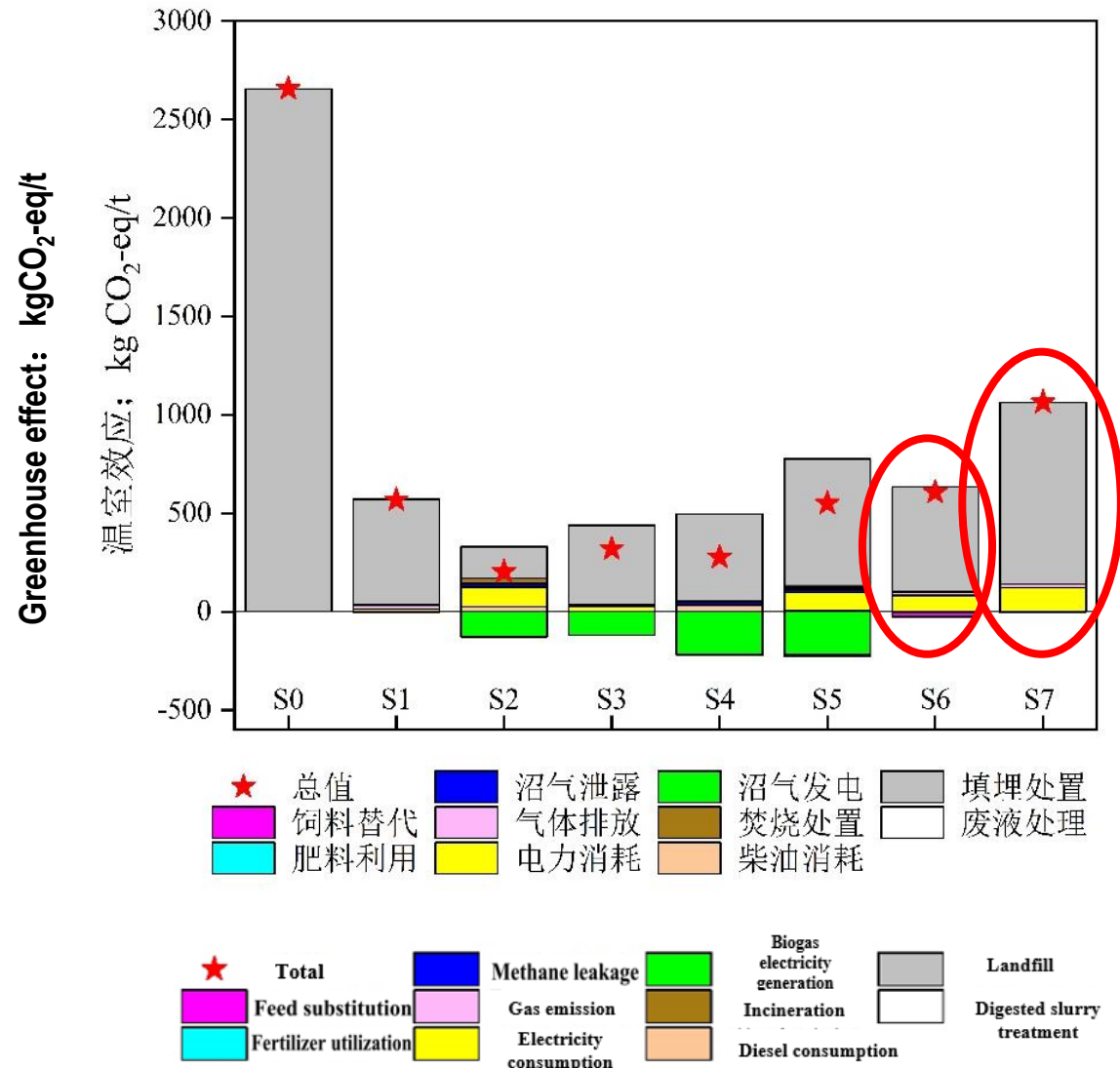


厨余处理：不同资源化技术路线碳减排效率评估

Kitchen Waste Treatment: carbon emission reduction efficiency evaluation of different resource technology routes

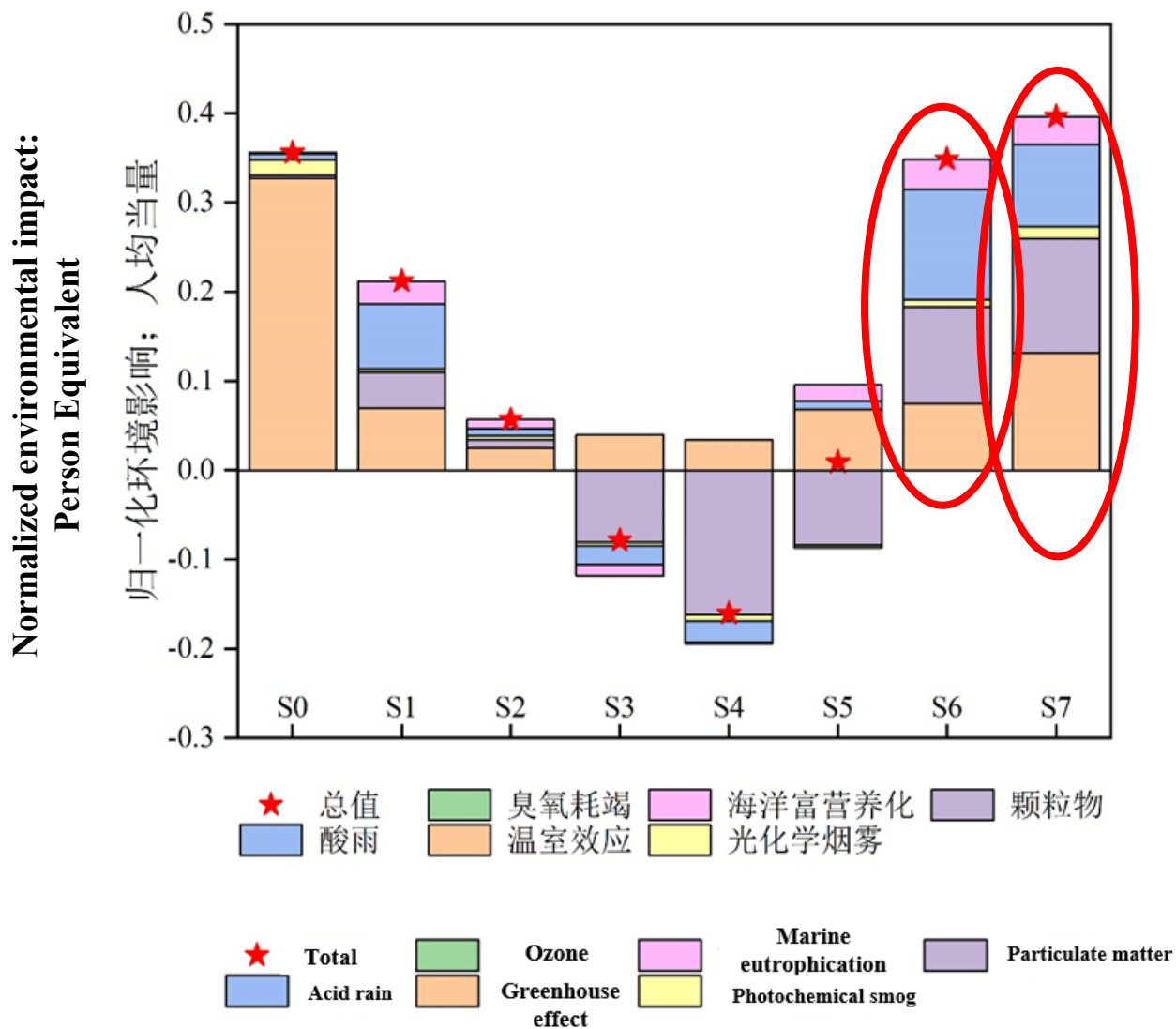
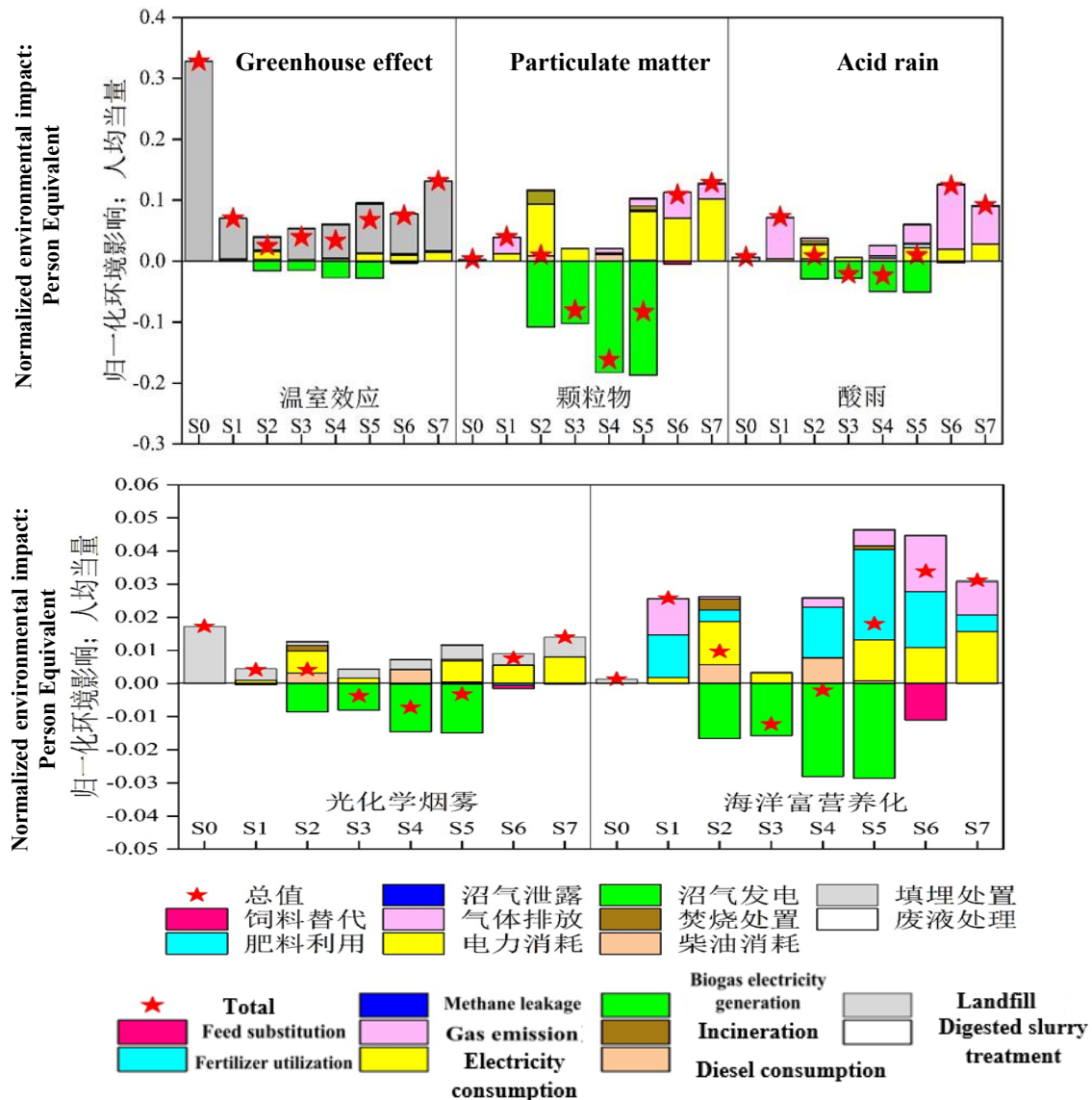
	预处理单元	主处理单元	最终出路
S1	分选+除杂	好氧堆肥	有机肥/填埋
S2	破碎制浆+三相分离	湿式厌氧	沼气利用/油脂回收/焚烧
S3	湿热水解	湿式厌氧	沼气利用/堆肥/填埋
S4	湿热水解	湿式厌氧	沼气利用/有机酸/填埋
S5	分选+除杂	干式厌氧	沼气利用/堆肥/填埋/焚烧
S6	破碎制浆	昆虫转化	高温灭菌/有机肥/填埋
S7	分选+除杂	堆肥机	有机肥/残渣填埋

	Pretreatment unit	Main processing unit	Ultimate treatment
S1	Sorting + impurity removal	Aerobic composting	Organic fertilizer / landfill
S2	Crushing pulping separation	Wet anaerobic	Biogas utilization / oil recovery / incineration
S3	Hydrothermal hydrolysis	Wet anaerobic	Biogas utilization / composting / landfill
S4	Hydrothermal hydrolysis	Wet anaerobic	Biogas utilization / organic acid / landfill
S5	Sorting + impurity removal	Dry anaerobic	Biogas utilization / composting / landfill / incineration
S6	Crushing pulping	Insect transformation	High temperature sterilization / organic fertilizer / landfill
S7	Sorting + impurity removal	Composter	Organic fertilizer / residue landfill



厨余处理：不同资源化技术路线综合环境影响评估

Kitchen Waste Treatment: comprehensive environmental impact assessment of different resource technology routes



回收利用：规范管理两网融合实现转型升级

Recycling: standardized management, integration of two networks, transformation and upgrading

- 再生资源也是垃圾的组成部分，“两网融合”是经济社会发展进步的**必然趋势**
 - “小散乱污低”的再生资源回收不符合经济社会发展要求，被时代淘汰是**必然结局**
 - 改变市场主导再生资源回收、政府主导垃圾收运处理的二元分治模式是**必然要求**
 - 提高产业集聚度、拓展延伸产业链、提升再生产品质量，实现转型升级是**必然选择**
- Renewable resource is also an integral part of garbage. "Integration of two networks" is an **inevitable trend** of economic and social development and progress
 - The recycling of "small, scattered, low, pollution" renewable resources does not meet the requirements of development, and it is an **inevitable outcome** to be eliminated
 - It is an **inevitable requirement** to change the dual governance model of market led recycling of renewable resources and government led garbage collection and treatment
 - It is an **inevitable option** to improve the degree of industrial agglomeration, expand and extend the industrial chain, improve the quality of recycled products



传统的再生资源回收行业
Traditional renewable resource recycling industry

信息化的快递/外卖行业
Information based express / takeout industry

回收利用：利益分配失衡导致因陋就简脱离监管

Recycling: the imbalance of benefit distribution leads to simplification and separation from supervision

Expenditure

- Waste acquisition
- Facility input
- Environmental protection investment
- Personnel input

支出

废物收购
设施投入
环保投入
人员投入



收入

产品销售

Income

Product sales

回收利用：“开源节流”促进回收收益多元化稳定化

Recycling: "increasing revenue and reducing expenditure" to promote the diversification and stability of recycling income

Expenditure

Waste acquisition
Facility input
Quality input
Environmental protection
investment
Personnel input

支出

废物收购
设施投入
质量投入
环保投入
人员投入



收入

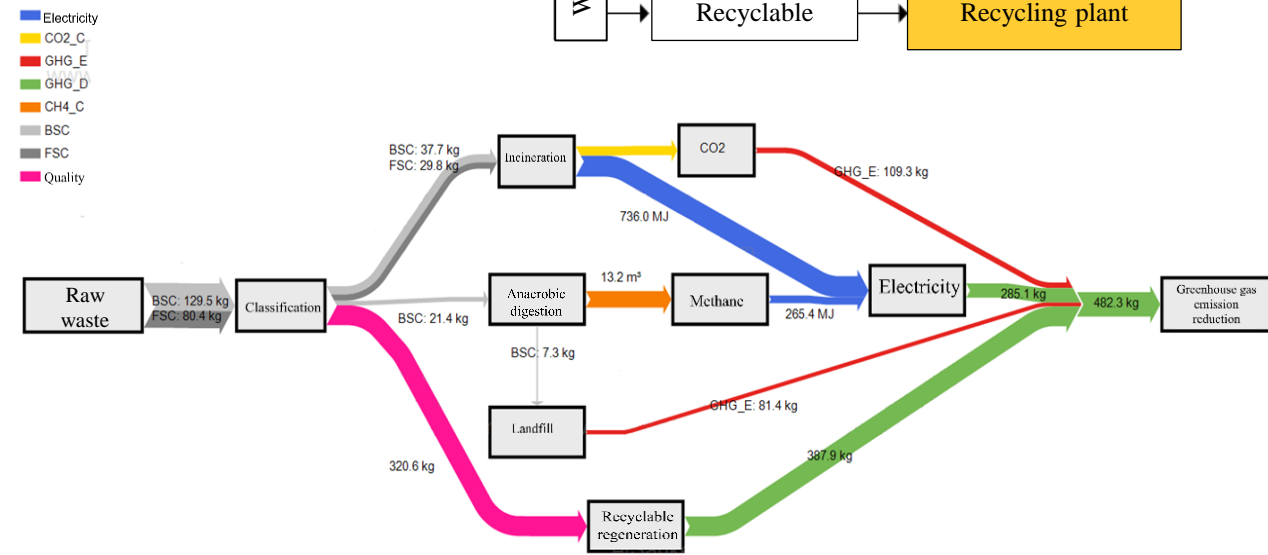
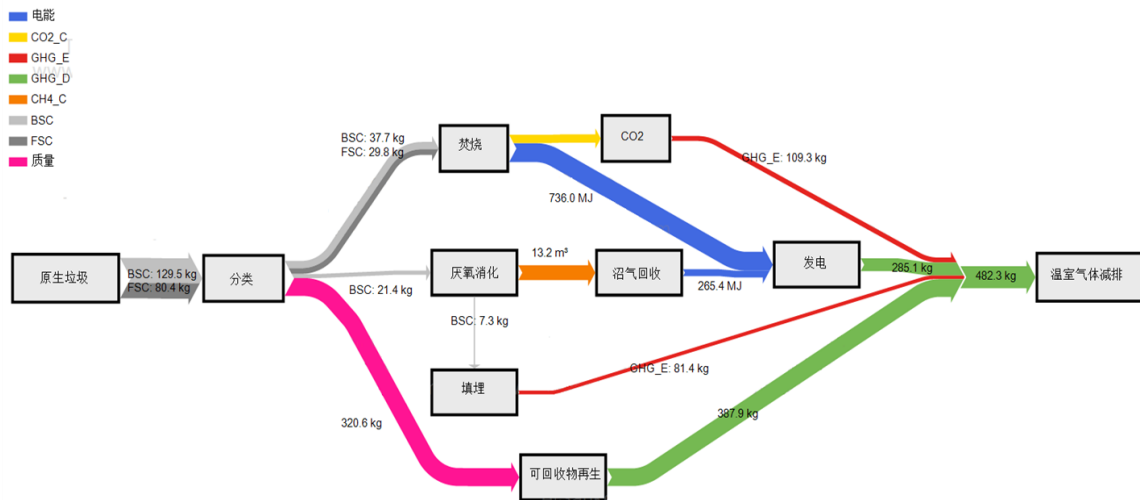
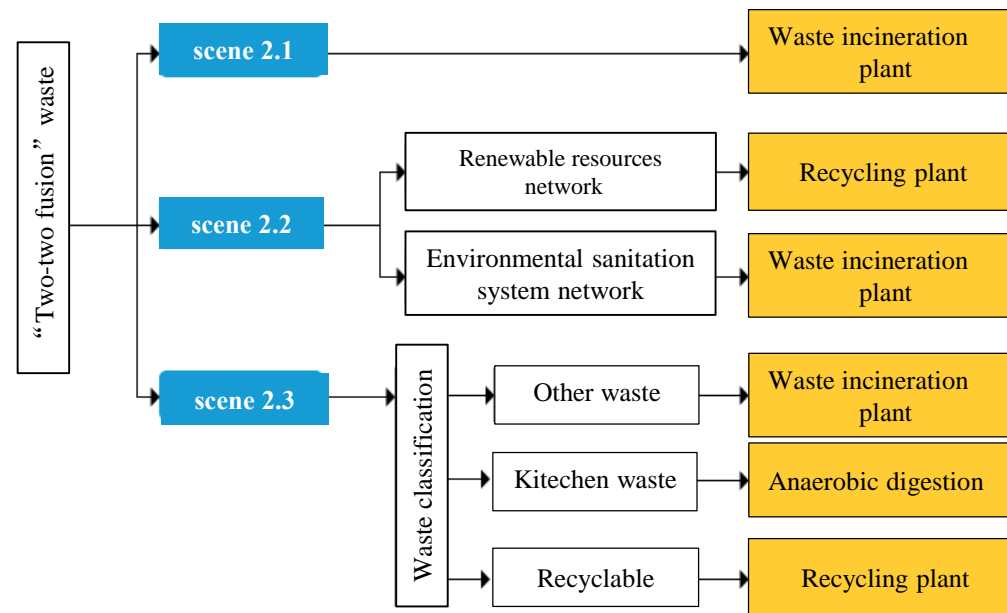
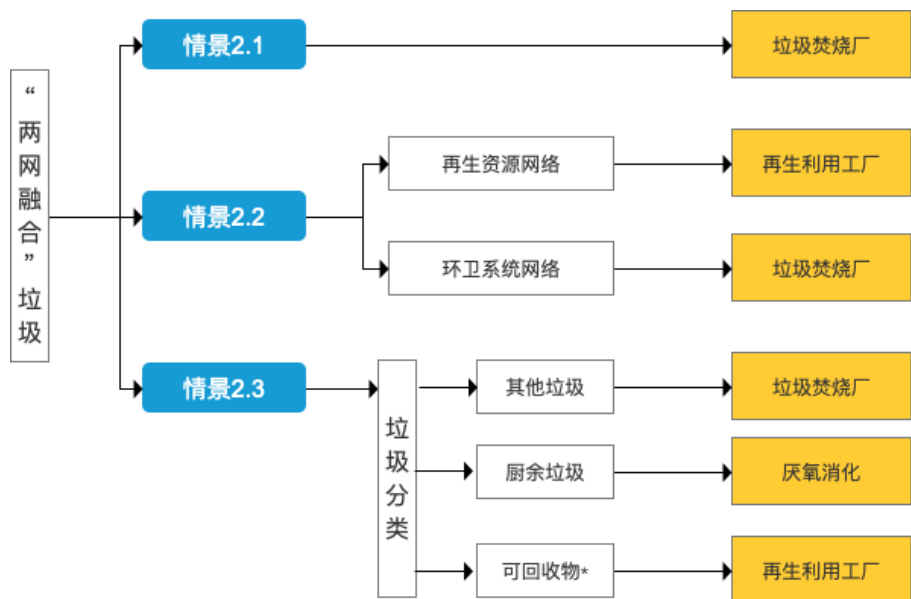
EPR资金
押金
政府补贴
产品销售

Income

EPR funds
Deposit
Government subsidies
Product sales

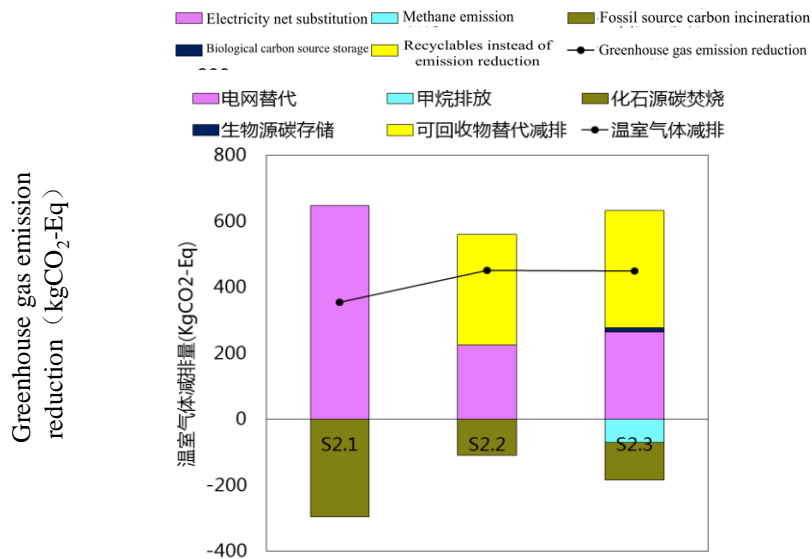
回收利用：两网融合可显著提升垃圾分类碳减排效益

Recycling: the integration of the two networks can significantly improve the carbon emission reduction benefits of waste classification



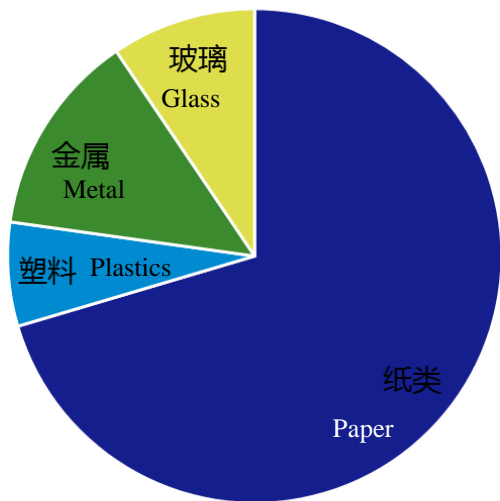
回收利用：两网融合可显著提升垃圾分类碳减排效益

Recycling: the integration of the two networks can significantly improve the carbon emission reduction benefits of waste classification



可回收物回收贡献系统温室气体减排量的56%!

Recyclables contribute 56% of the greenhouse gas emission reduction !

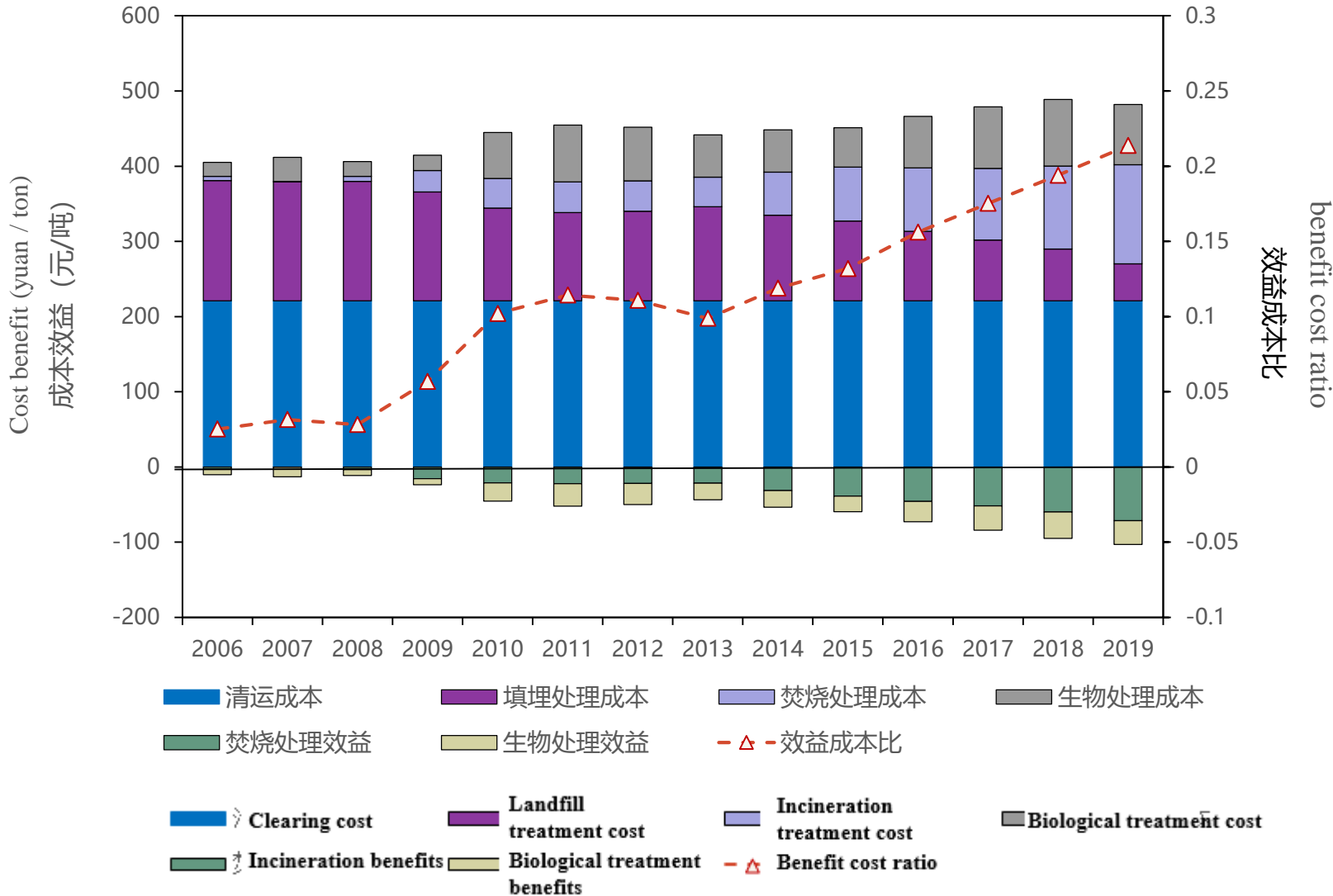


不同可回收物对温室气体减排的贡献纸类最大，金属次之，其次为玻璃、塑料

Different recyclables contribute the most to greenhouse gas emission reduction, followed by paper, metal, glass and plastic

长效机制：垃圾处理经济效益与收费远不能覆盖成本

Long term Mechanism: the economic benefits and charges of waste treatment are far from covering the cost

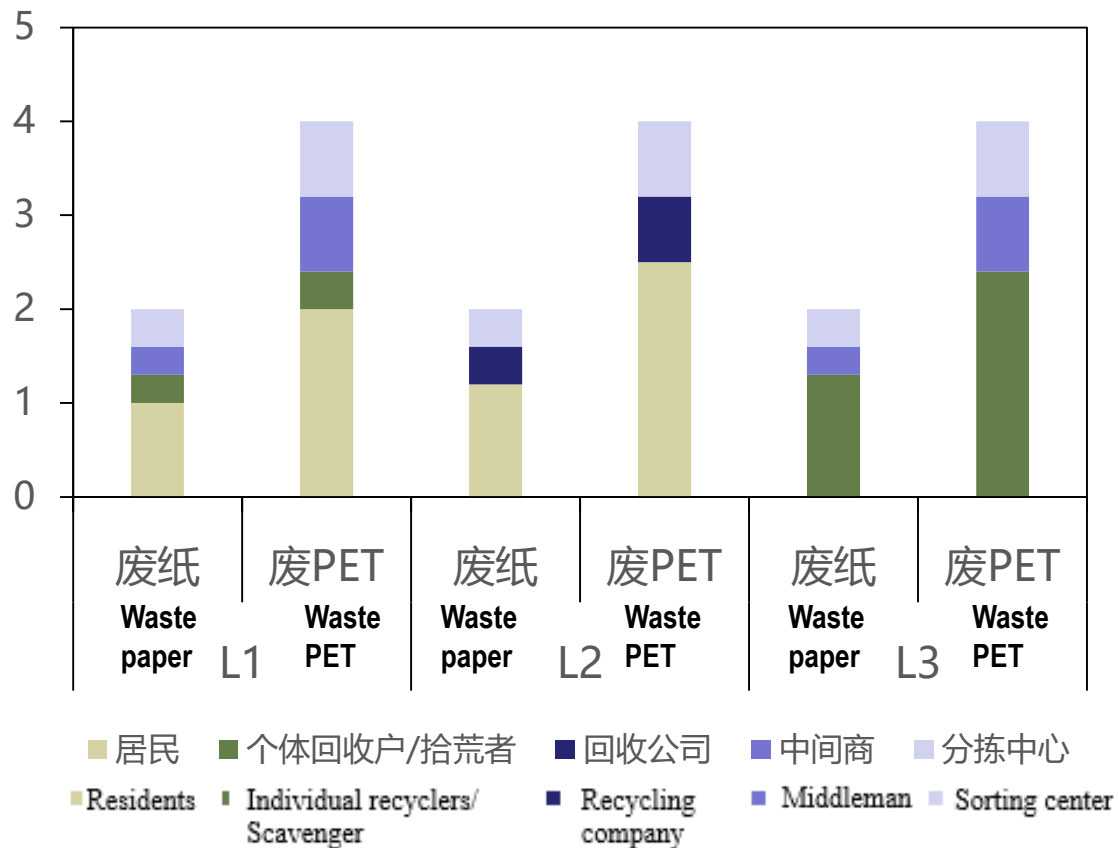


- ✓ 生活垃圾处理产生的效益仅占处理成本的21%
- ✓ 垃圾处理费仅占处理成本的约5%

- ✓ The benefits of domestic waste treatment account for only 21% of the treatment cost
- ✓ The waste treatment fee only accounts for about 5% of the treatment cost

长效机制：可回收物回收链条利益分配严重失衡

Long term Mechanism: the distribution of interests in the recycling chain of recyclables is seriously unbalanced



L1: 居民—个体回收户—中间商—分拣中心

L2: 居民—回收公司—分拣中心

L3: 拾荒者—中间商—分拣中心

L1: Residents - Individual recyclers - Middlemen - Sorting center

L2: Resident - Recycling company - Sorting center

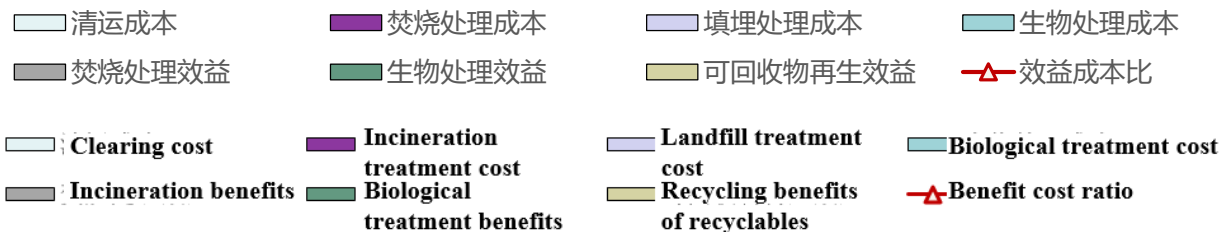
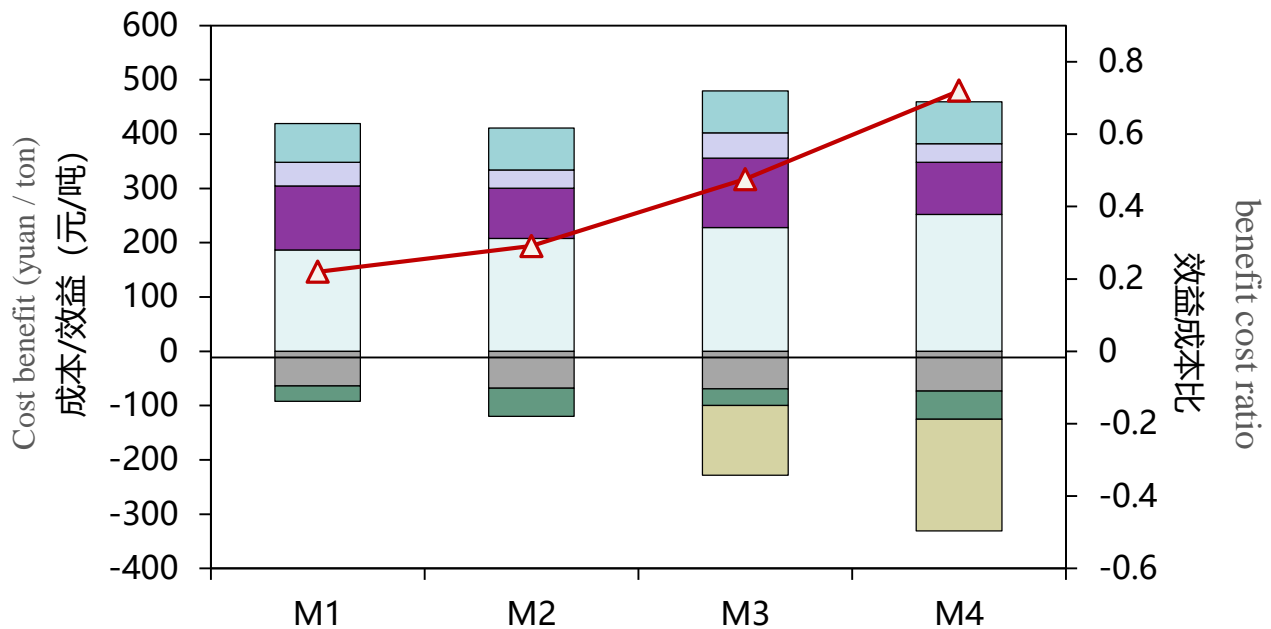
L3: Scavenger - Middleman - Sorting center

- ✓ 对高值可回收物，居民、拾荒者和个体回收户拥有了整个回收链条50%-70%的利润，回收业者利润微薄
- ✓ 回收环节众多，站点分散，效率低下且存在灰色地带，导致下游环节成本升高利润压缩
- ✓ 对低值可回收物，回收利益链的断裂导致回收过程物质链的断裂

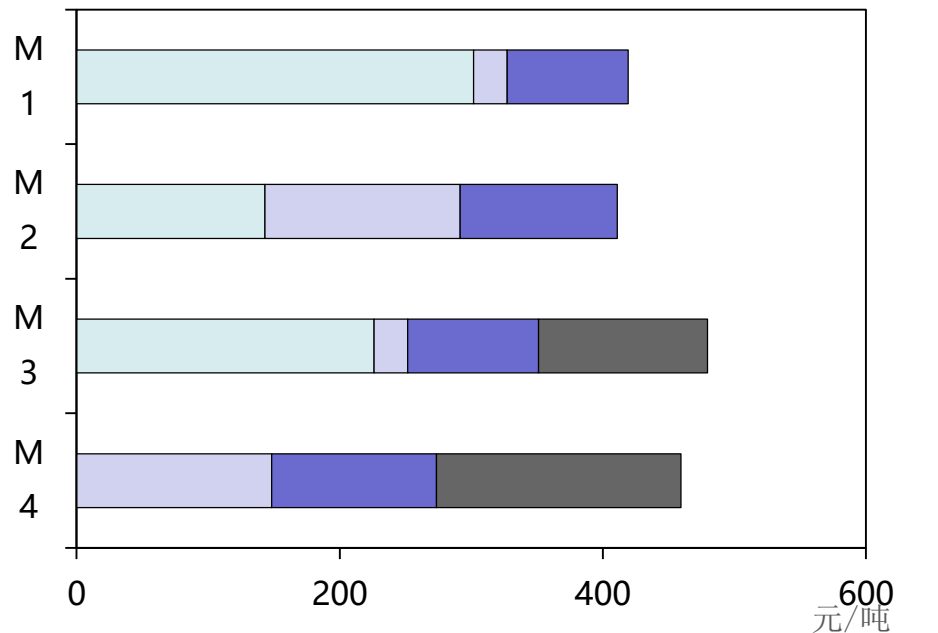
- ✓ For high-value recyclables, residents, scavengers and individual recyclers have 50% - 70% of the profits of the whole recycling chain, and the profits of the recycling industry are meager
- ✓ There are many recycling links, scattered sites, low efficiency and gray areas, resulting in increased costs and profit compression in downstream links
- ✓ For low value recyclables, the rupture of the recycling interest chain leads to the rupture of the material chain in the recycling process

长效机制：推行差异化收费和EPR落实污染担责

Long term Mechanism: implement differentiated charges and EPR to take responsibility for pollution



四种场景下成本效益情况
Cost effectiveness in four scenarios



四种场景下各主体担责情况

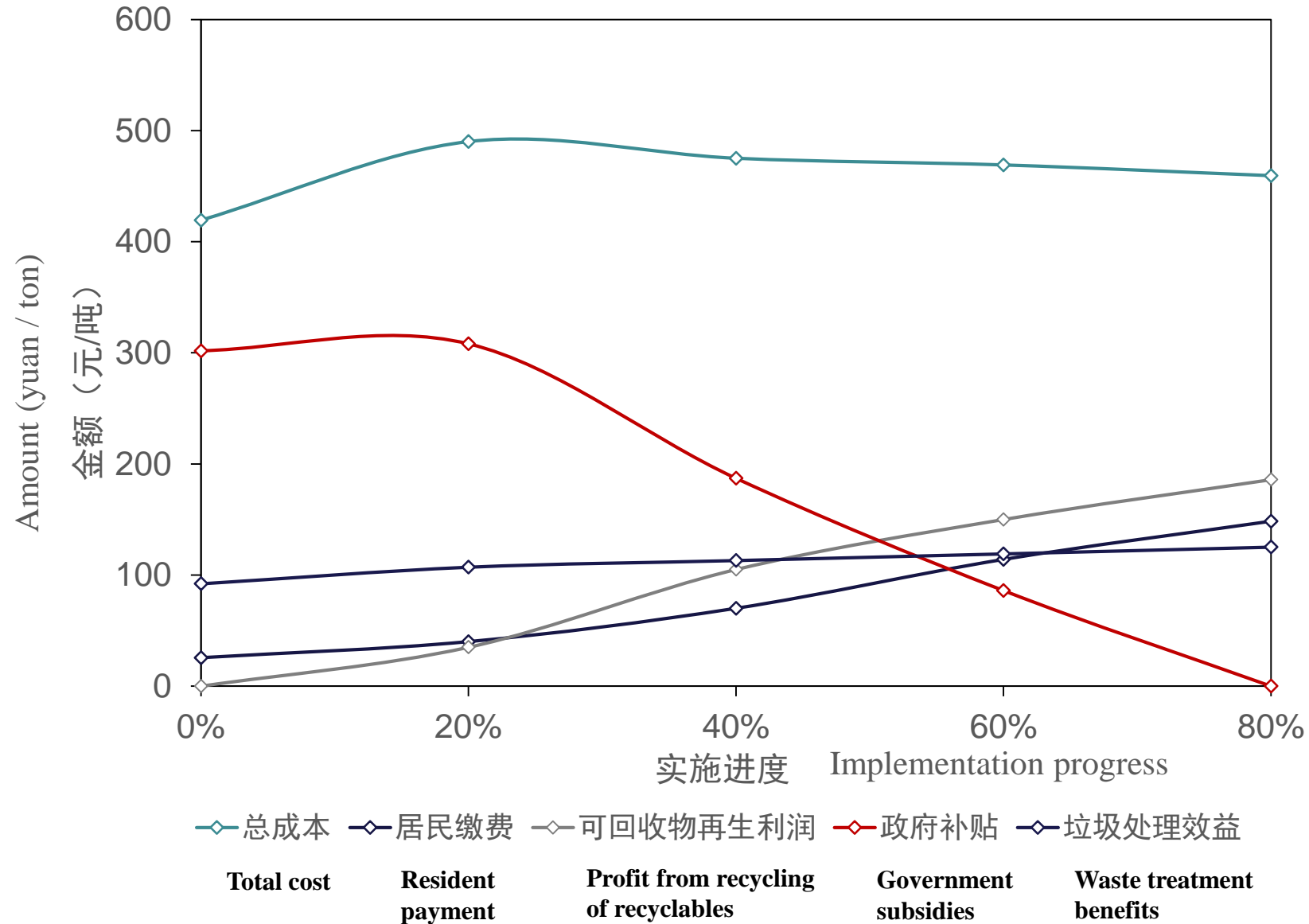
Responsibilities of each subject under the four scenarios

M1: 现状; M2: 差异化收费制度实施; M3: 生产者责任延伸制度实施; M4: 两种手段同时实施

M1: Current situation; M2: Implementation of differentiated charging system; M3: Implementation of extended producer responsibility system; M4: Simultaneous implementation

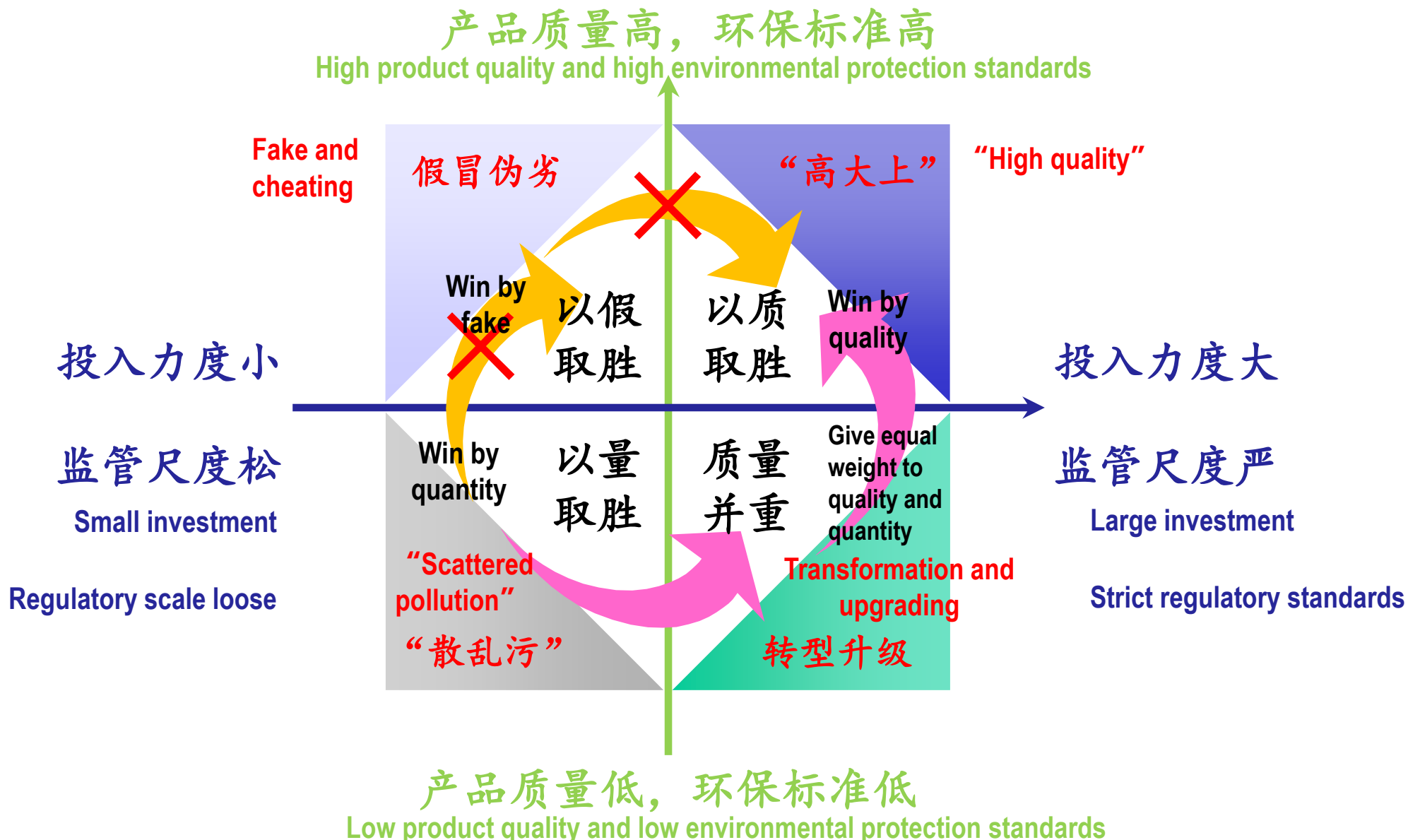
长效机制：推行差异化收费和EPR降低财政负担

Long term Mechanism: implement differentiated charges and EPR to reduce the financial burden



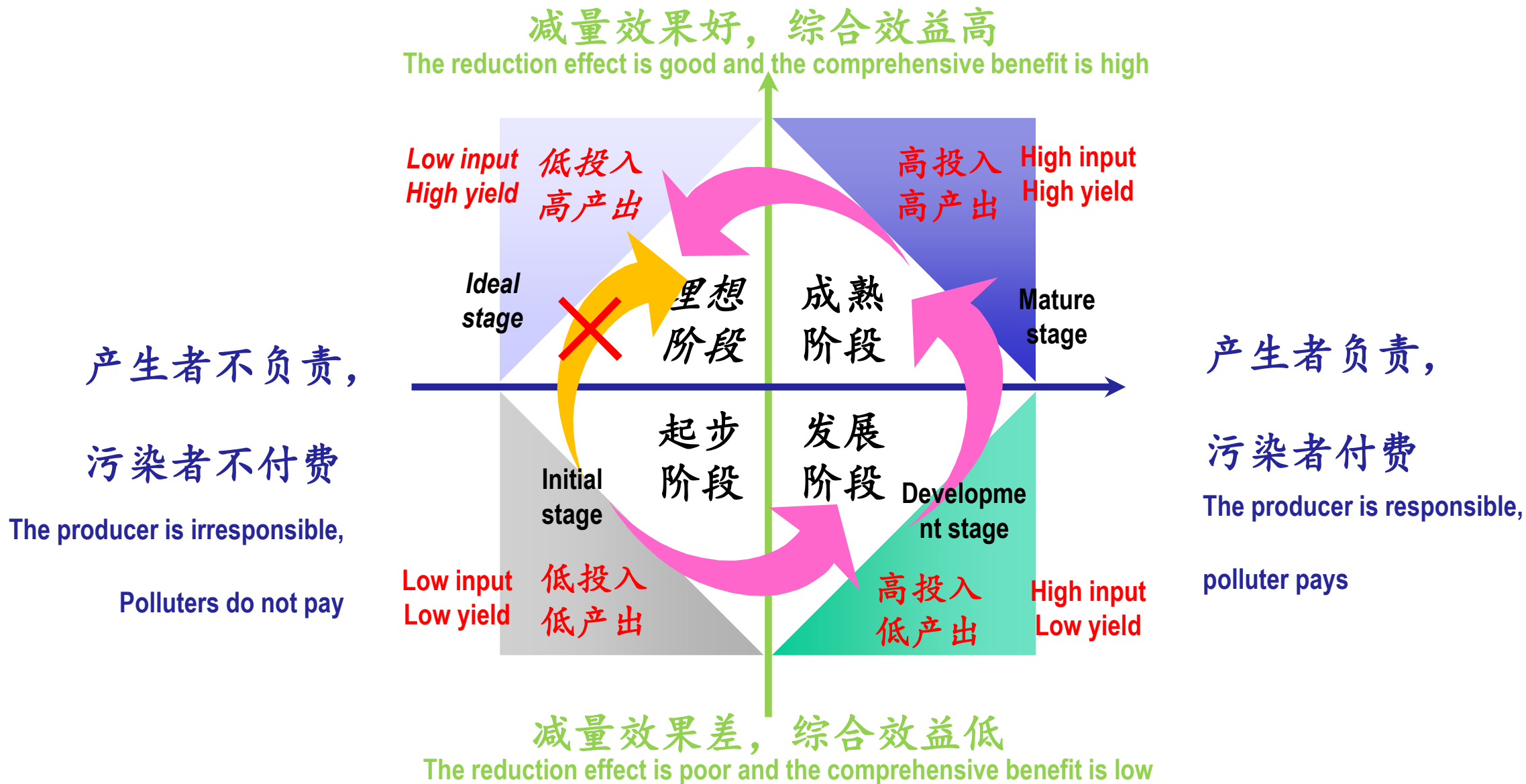
加大投入加强监管推动高质量分类

Increase investment, strengthen supervision and promote high-quality classification



产生者负责污染者付费推动可持续分类

Producers are responsible, polluters pay, and promote sustainable classification as a whole





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谢谢大家，欢迎交流

Thank you and welcome to communicate

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Environmental comment

