生态卫生技术的区域复合生态效益：
——基于黄土高原地区城市的情景分析

The Regional Eco-Benefits Through Adopting Ecological Sanitation Technologies
---- Scenarios Analysis of Chinese Cities in Loess Plateau

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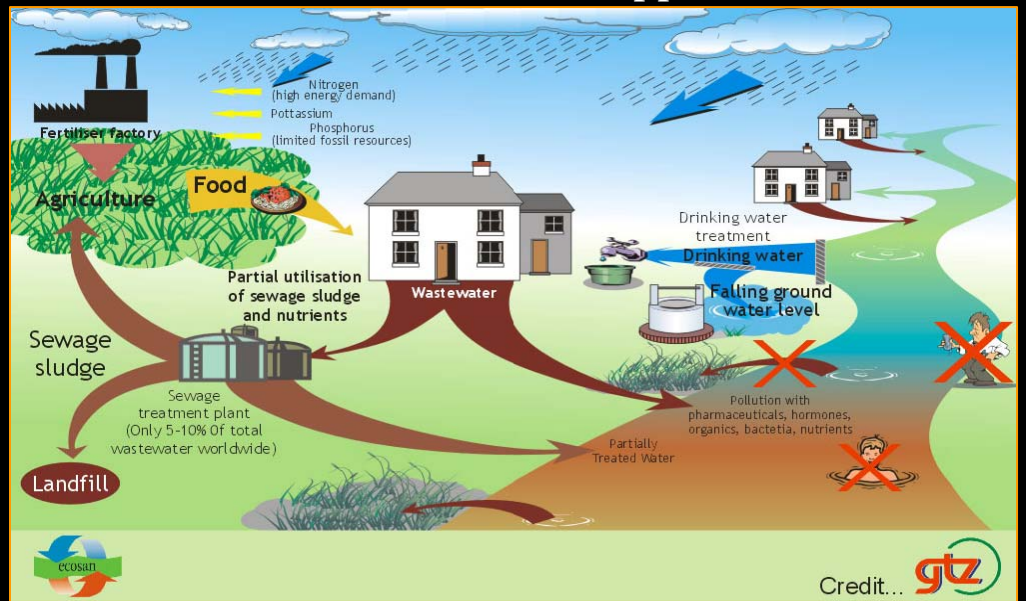
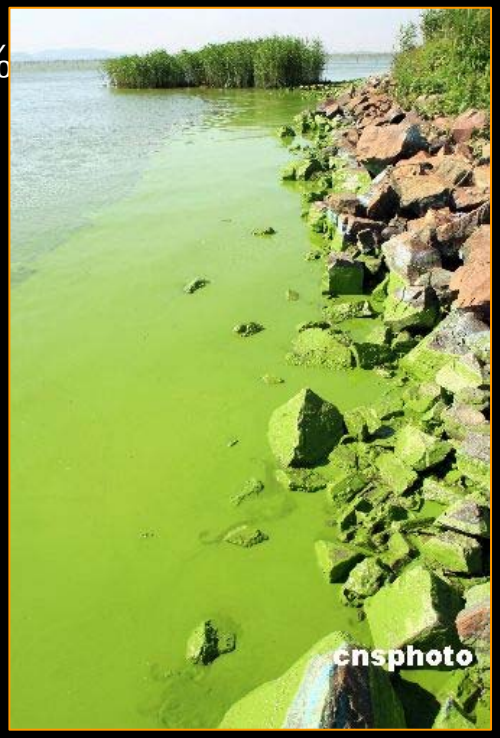
1. Foreword

Statistics taken by Ministry of Construction in year 2005:

1. 27% of 410 surface water monitoring points in are found to be of low-grade water quality.
2. 72% of 222 surface water drinking-water sources in 113 key environmental protection cities come up to the standards in regard to the water quality.
3. 42% of cities are in short of sewage treatment facilities.
4. The treatment capacity of domestic garbage increases by 20% harmless treatment rate has dropped from 61% to 53%.



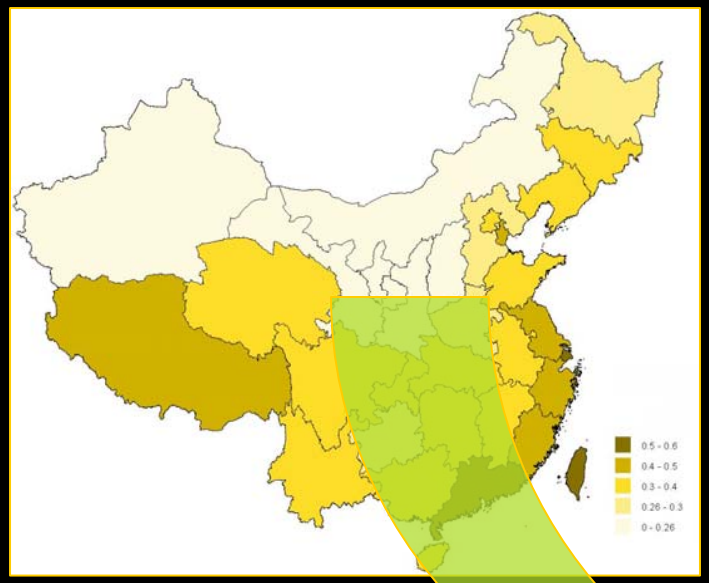


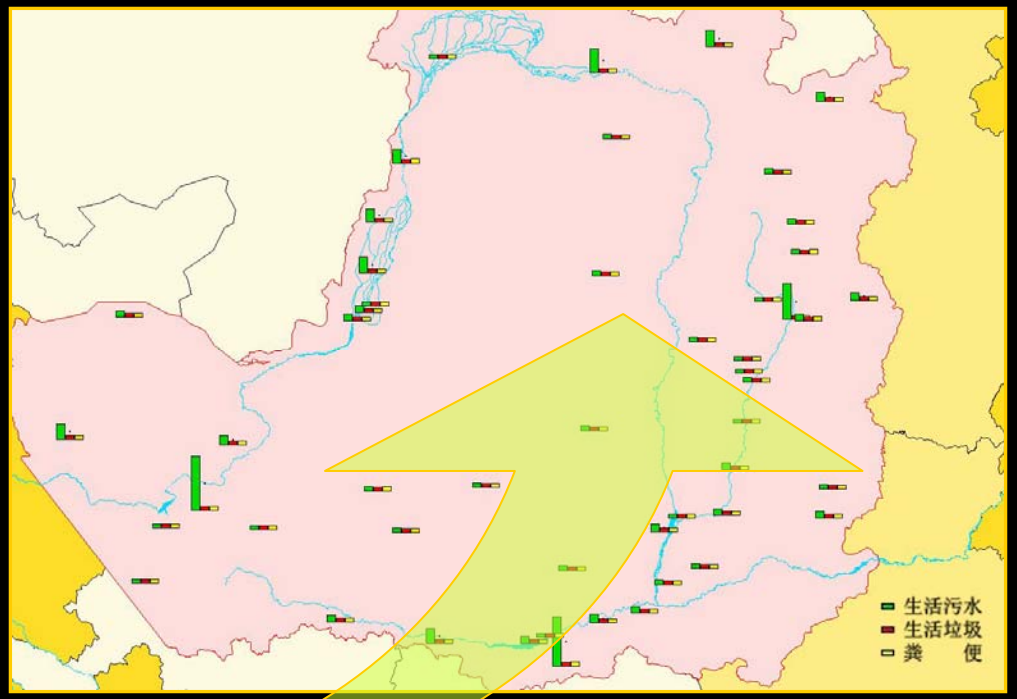
1. Foreword

As an effective way to address the urban & rural environment, public health and human health related problems, ecosan respects the ecological integrality and is aimed to improve the living quality and health level of residents by means of harmless treatment and cyclic utilization of organic wastes, as well as to protect the drinking water and the biomass resources.

2. Study areas and study approaches

General aspect of the study areas:
(loess plateau areas: 51 cities of 6 provinces as Qinghai, Inner Mongolia, Shanxi, Shanxi, Ningxia and Gansu)

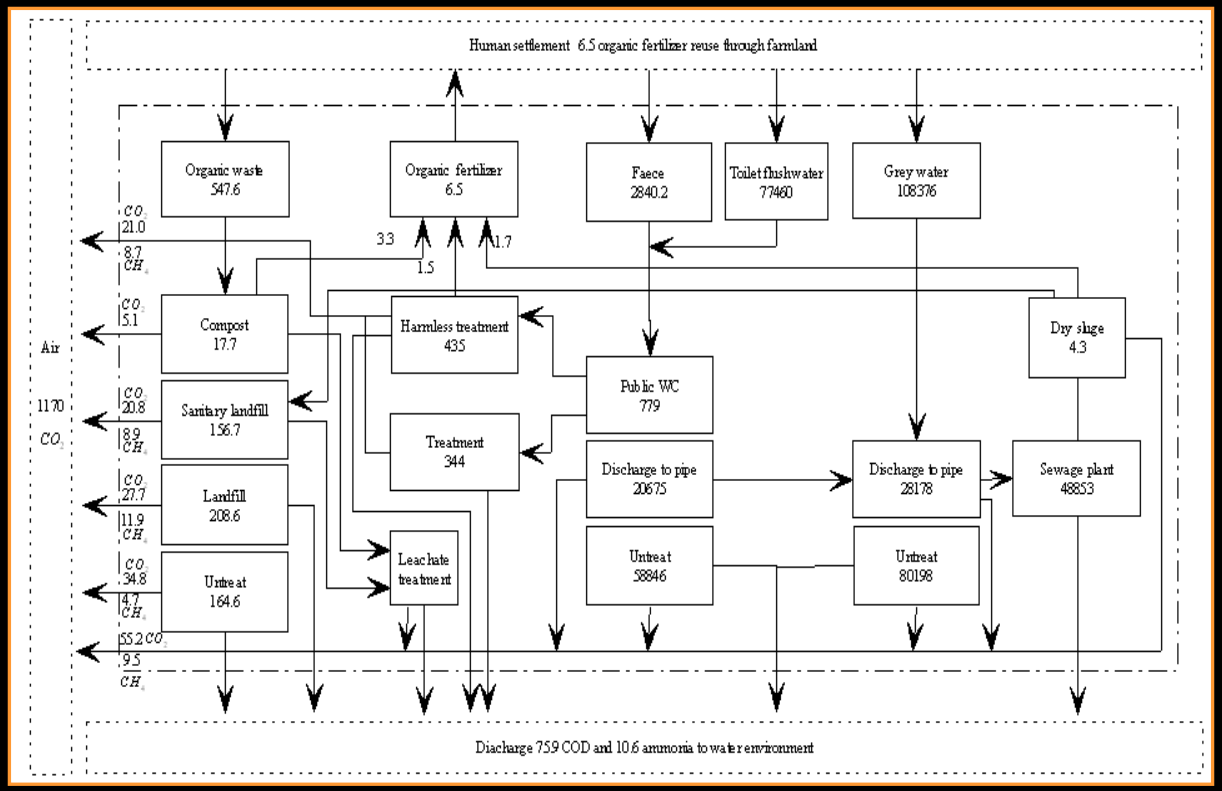




Regional characteristics:

- ❖ Lean soil: organic matter of soil <1%
- ❖ Drought: per capita surface water quantity: 37%; per capita ground water quantity: 62%; average precipitation: 39%
- ❖ Lagged development: per capita GDP being 63% of the national average level.

2. Study areas and study approaches



The urban sanitation system flow of the loess plateau areas

Characteristics of the built-up urban sanitation system:

- Landfill of domestic wastes (limited composting)
- Centralized treatment of feces
- Centralized treatment of sewage

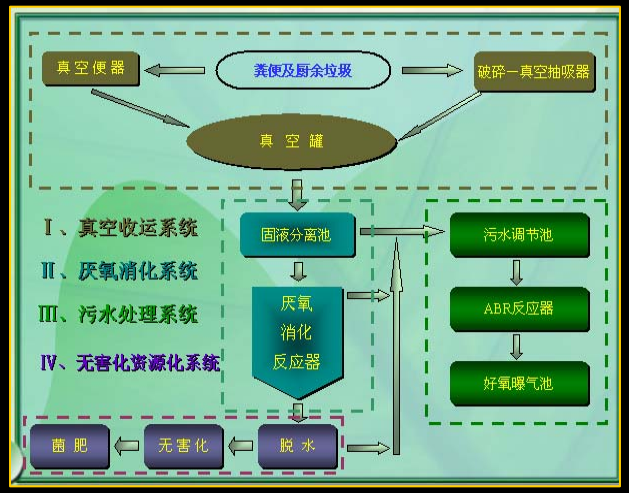
2. Study areas and study approaches

Technical matrix

Organic solid waste	Faeces	Urine	Grey water
M1 Central landfill	F1 Central sewage plant	U1 Central sewage plant	
M2 Central compost	F2 Central faeces plant	U2 Central faeces plant	S1 Central sewage plant
M3 Central digest			
M4 Decentral compost	F3 Decentral compost	U3 Decentral digest	S2 Decentral sewage facility
M5 Decentral digest	F4 Decentral digest	U4 Storage	

Technical integration

Rural sewage treatment in Jinhua, Zhejiang



Experimental study on the centralized wastes and feces treatment in urban communities

Erdos Eco-town

2. Study areas and study approaches

Method for the calculation of major technical economical indexes of ecosan technologies

1. Method for the calculation of greenhouse emission and methane utilization potential
2. Method for the calculation of water pollutant discharge
3. Method for the calculation of nutrient recycling potential
4. Method for the calculation of capital construction inputs and operating costs

2. Study areas and study approaches

Method for the calculation of compound ecological benefits

(1) method for the evaluation of greenhouse emission and methane utilization & emission reduction

(2) method for the calculation of valley water pollutant discharge

(3) method for the calculation of nutrient recycling and grain supply

Calculate the average value (even distribution under all technological modes), maximum value and minimum value under all circumstances in accordance with the population forecasting.

(4) method for the calculation of integrated economic benefits

The calculation of integrated economic benefits has to consider the input costs and the output benefits. The input costs include the costs of capital construction facilities and the operating costs, while the output benefits include the revenue derived from methane utilization (methane power generation; the net annual profit after subtracting the power generation input and the operating costs), the revenue derived from methane emission reduction (emission reduction benefit under the mechanism of clean development: 8$/t CO2e), the revenue derived from greywater recycling (the net annual profit after subtracting the input of greywater treatment facilities and pipelines and treatment costs), the revenue derived from fertilizers (market value of K\P\K after being converted into a certain proportion of fertilizer).

3. Outcomes and analysis

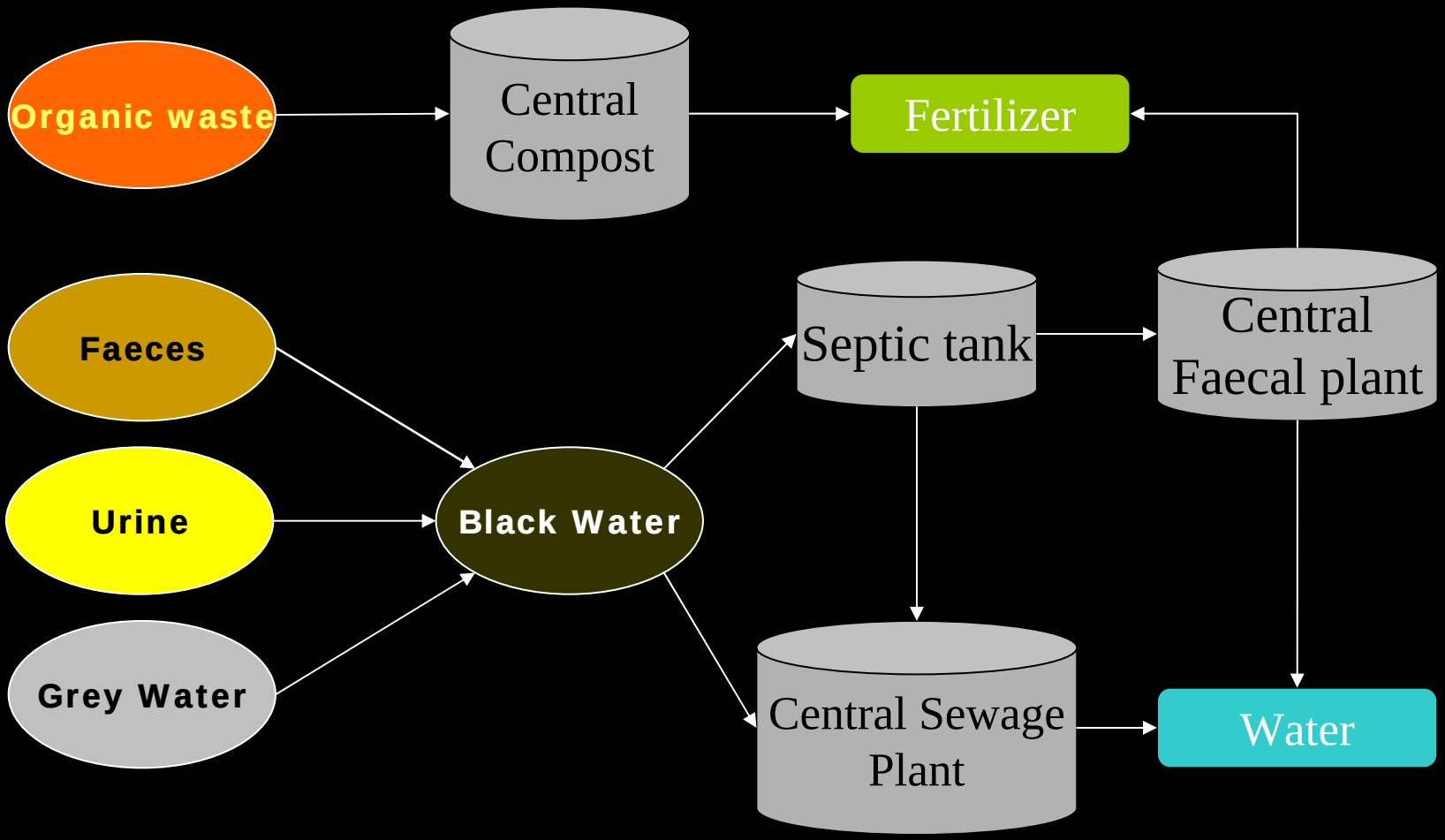
Analysis on the appropriate integration technologies

ID	Integration technologies	Type of technical combination
C1	Centralized landfill of wastes + centralized feces & wastes treatment (the traditional mode of end treatment)	centralized
C2	Centralized landfill of wastes + centralized feces & wastes treatment (strengthen the utilization of landfill gas and sewage sludge)	centralized
C3	Centralized treatment of wastes, feces and urine + centralized treatment of sewage	centralized
C4	Centralized treatment of wastes, feces and urine + centralized treatment of sewage	centralized
D1	On-site composting of wastes and feces + storage and utilization of urine + on-site treatment of sewage	decentralized
D2	On-site treatment of wastes, feces and urine + on-site treatment of sewage	decentralized
D3	On-site treatment of wastes and feces + storage and utilization of urine + on-site treatment of sewage	decentralized
D4	On-site composting of wastes + on-site storage and utilization of urine + on-site treatment of sewage	decentralized

3. Outcomes and analysis

Analysis on the appropriate integration technologies

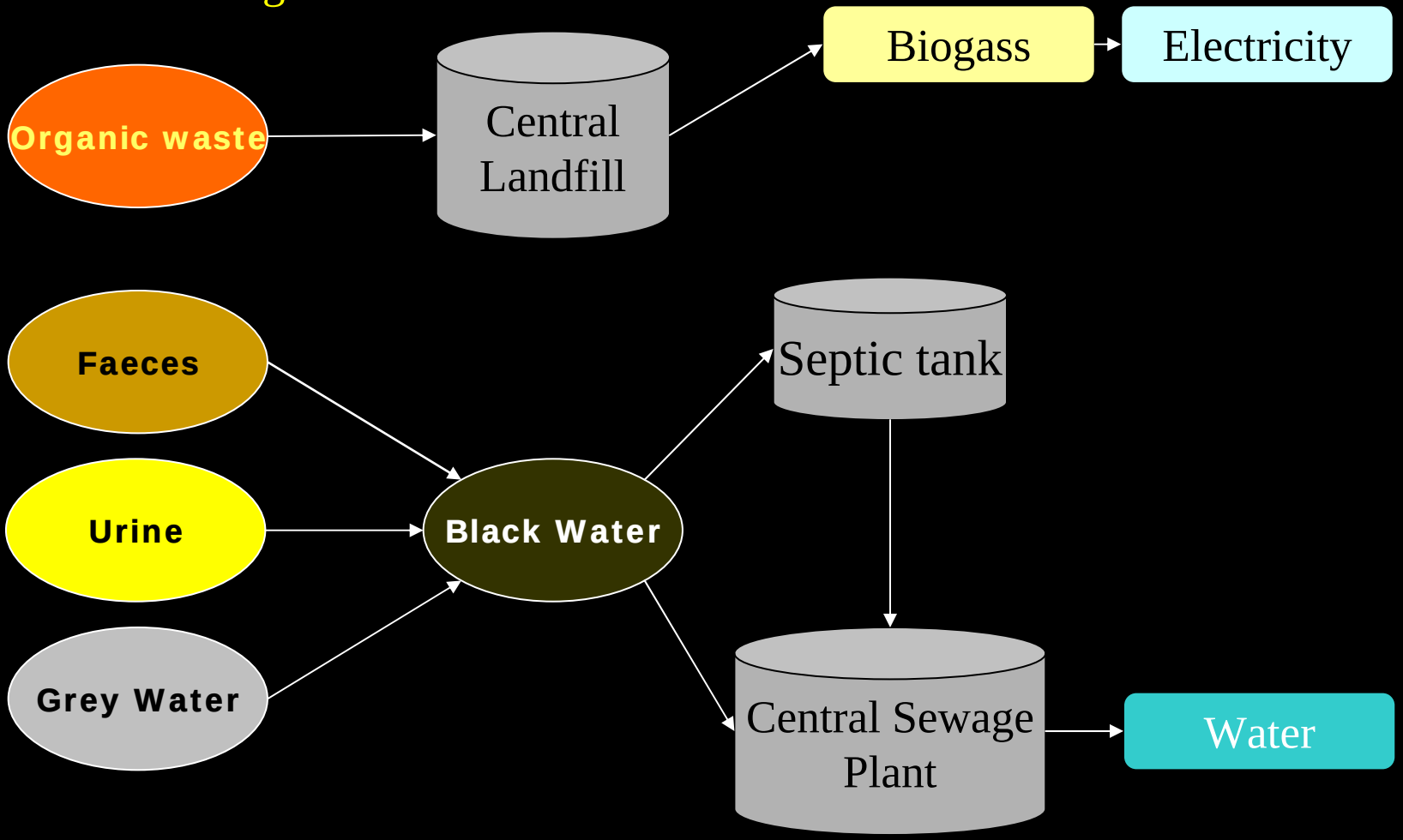
Central model for old urban areas



3. Outcomes and analysis

Analysis on the appropriate integration technologies

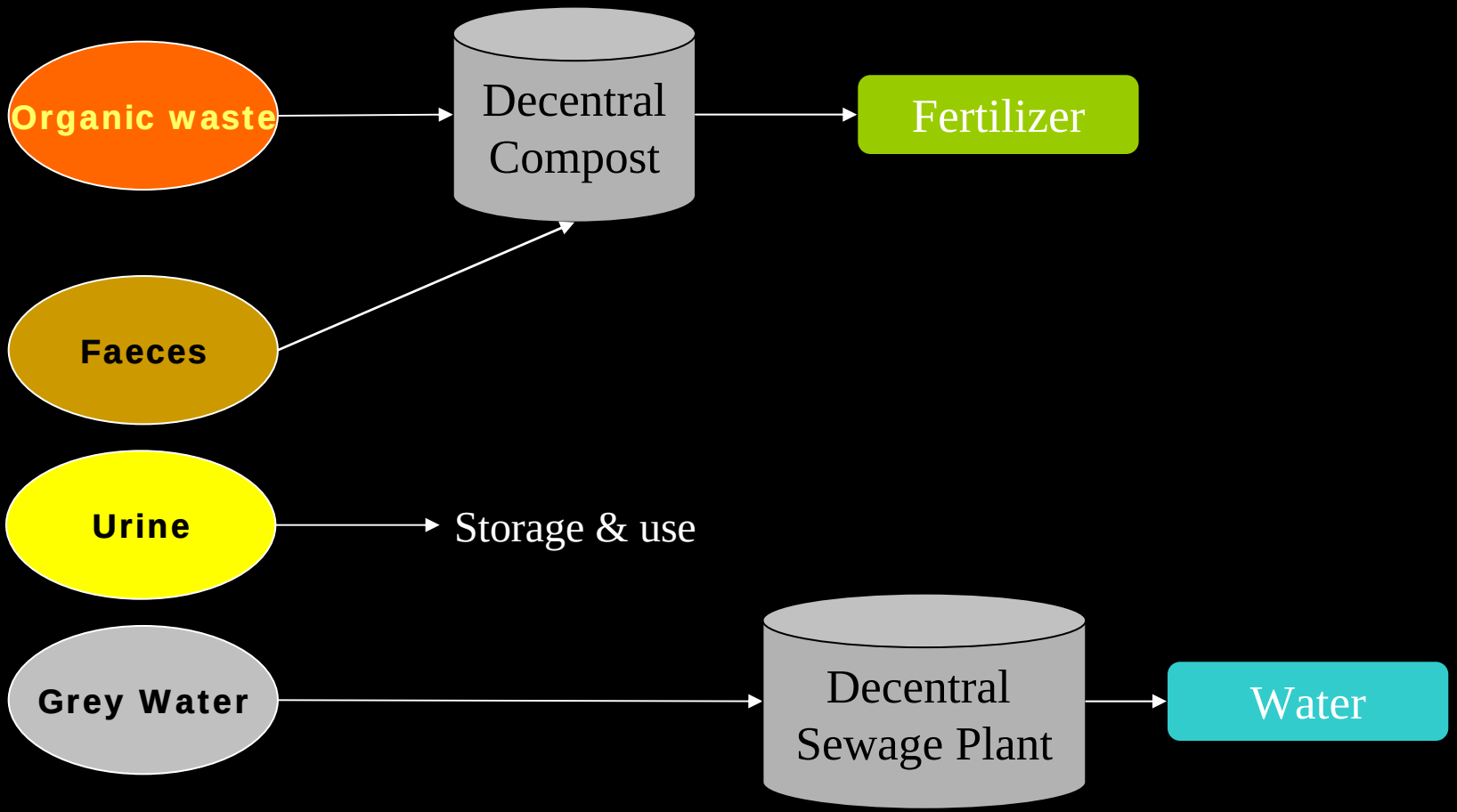
Central model for old urban areas



3. Outcomes and analysis

Analysis on the appropriate integration technologies

Decentral model for new built urban areas



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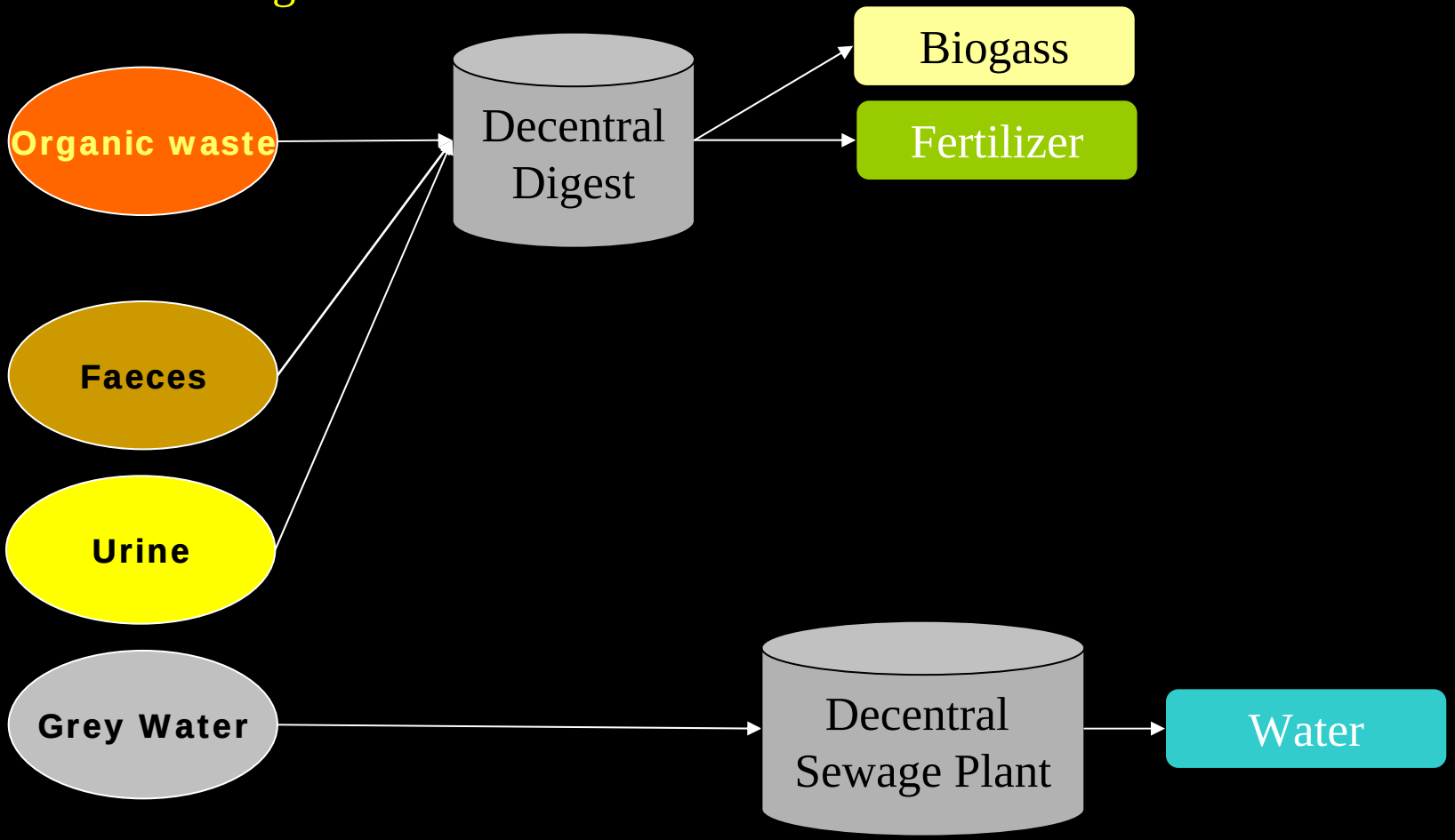

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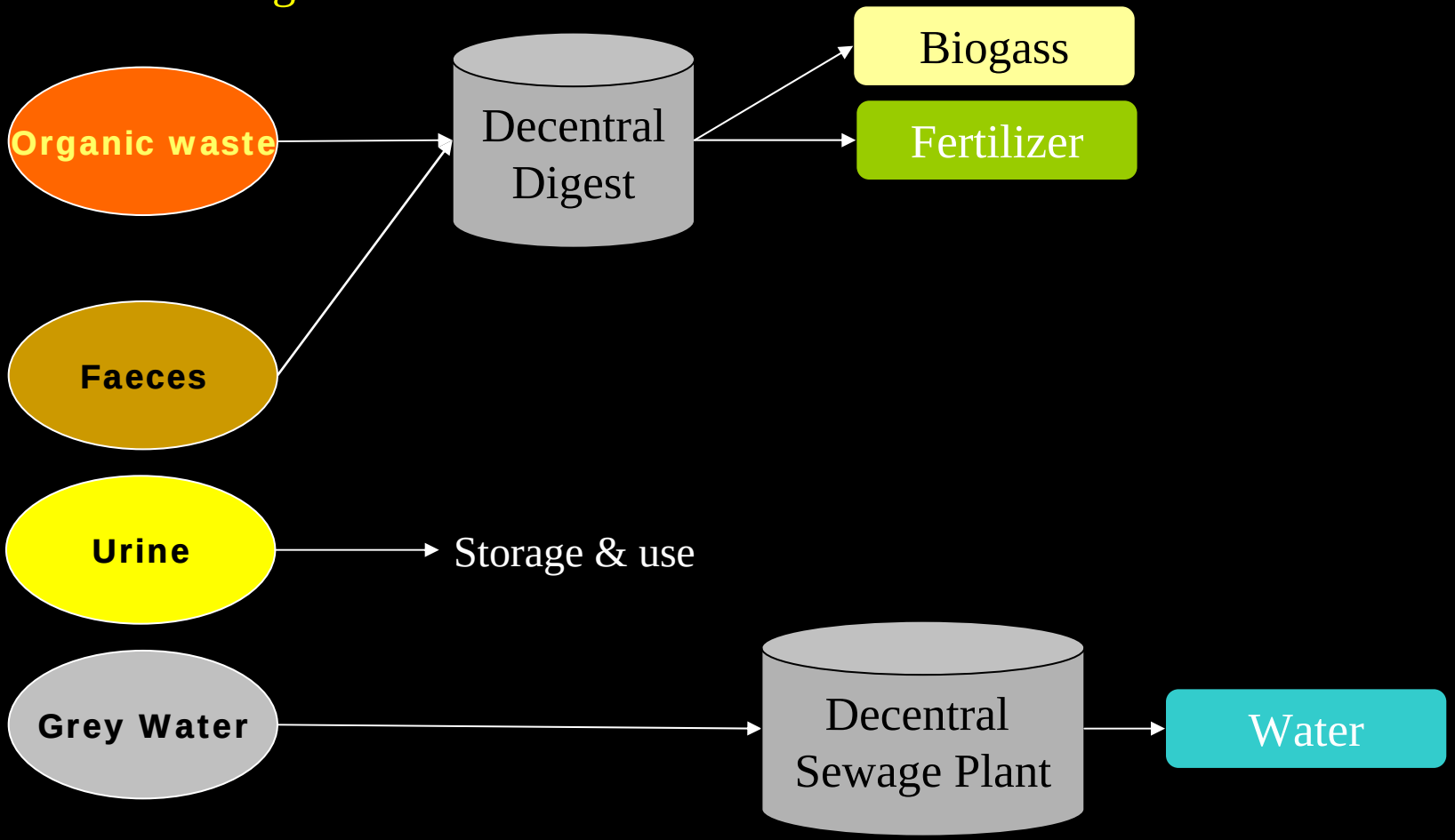


3. Outcomes and analysis

Calculation of related technical & economical indicators of the combination

ID	Greenhouse emission		Water pollutant discharge			Potential of nutrient recycling			Investment & operating costs		
	CH_4 Utilization	CO_2e emmision	BOD5	SS	NH3-N	N	P	K	Investment	Operation	Overall
	Ton/year	Ton/year	Ton/year	Ton/year	Ton/year	Ton/year	Ton/year	Ton/year	RMB 10000/year	RMB 10000/year	RMB 10000/year
C1	0.00	4150.13	10.99	11.00	9.13	0.35	0.08	0.35	34.63	38.67	73.30
C2	148.04	1041.21	10.99	11.00	9.13	0.35	0.08	0.35	34.63	38.67	73.30
C3	159.52	177.52	11.01	11.01	9.17	12.29	2.07	3.57	39.20	41.85	81.05
C4	4.38	198.65	10.95	10.95	9.13	12.29	2.07	3.57	36.16	39.51	75.67
D1	0.00	45.00	5.55	2.77	2.77	48.16	7.48	13.40	8.88	17.93	26.81
D2	164.24	32.85	7.30	3.65	3.65	13.92	2.96	5.20	14.15	24.03	38.18
D3	162.43	26.94	5.99	2.99	2.99	47.52	7.16	12.76	18.40	26.77	45.17
D4	7.29	47.96	7.30	3.65	3.65	7.52	2.16	3.76	17.38	30.31	47.69

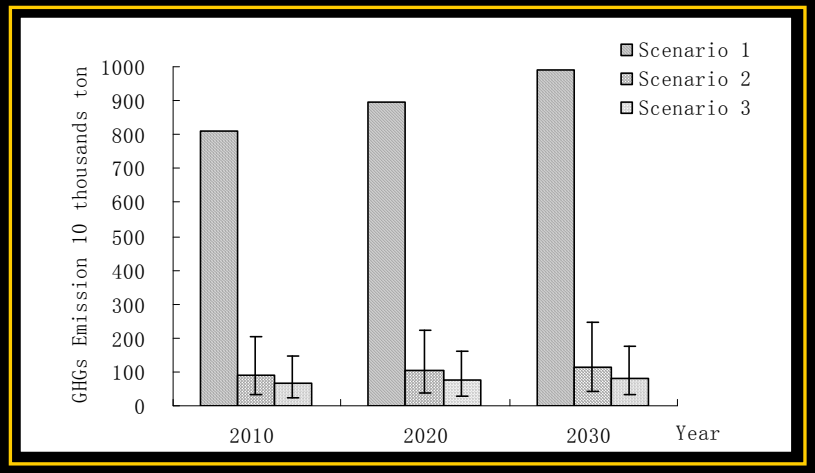
3. Outcomes and analysis

Scenario analysis:

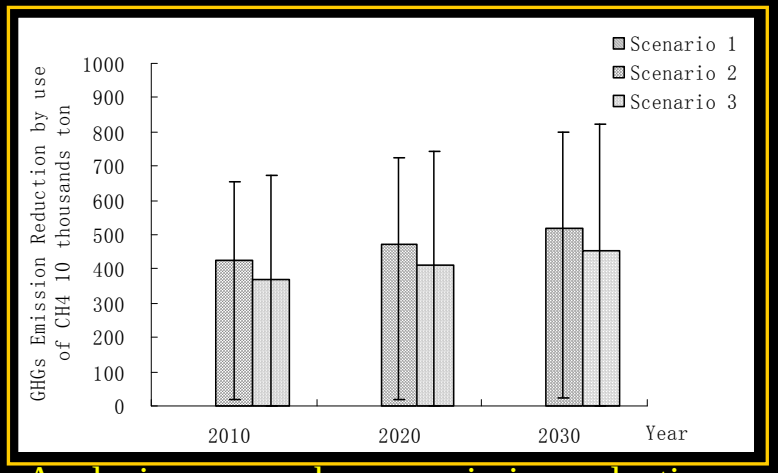
Scenario	Scenario 1: The traditional mode of end treatment	Scenario 2: Centralized ecosan mode	Scenario 3: Centralized-decentralized ecosan mode
Description	The technical system and managerial approach for the centralized end treatment of domestic wastes, feces and sewage, only ensuring harmless treatment of pollutants without cyclic utilization of resources.	Cyclic utilization of domestic wastes, feces and sewage at the end, ensuring harmless treatment of pollutants besides cyclic utilization of resources.	Decentralized ecosan mode for applicable urban areas (newly constructed urban areas) and centralized ecosan mode for old urban areas.
Technological mode	C1	C2~C4（1/3 respectively）	D1~D4（1/4 respectively ） C2~C4（1/3 respectively ）
Population covered by the centralized mode (10,000 persons)	2010：1952.8 2020：2157.1 2030：2382.8	2010：1952.8 2020：2157.1 2030：2382.8	2010：1367.0 2020：1510.0 2030：1668.0
Population covered by the decentralized mode (10,000 persons)	2010：0 2020：0 2030：0	2010：0 2020：0 2030：0	2010：585.8 2020：647.1 2030：714.8

3. Outcomes and analysis

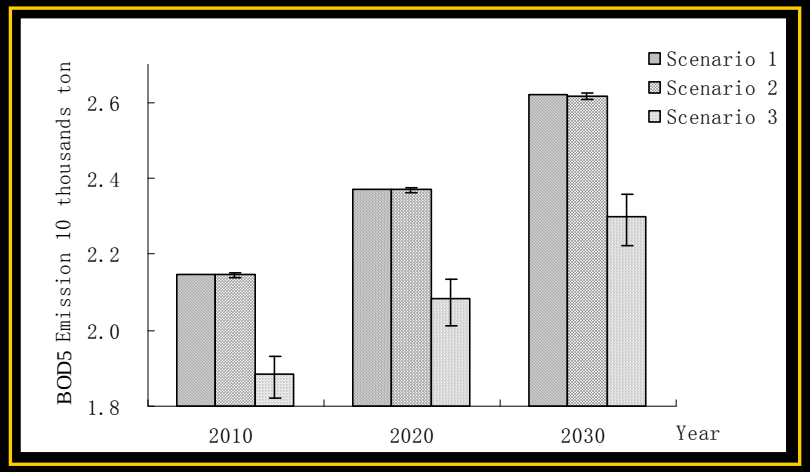
Scenario computation and analysis:



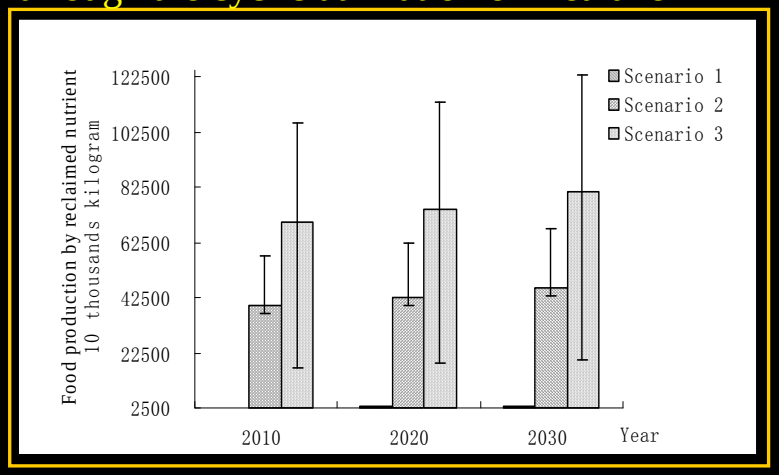
Scenario analysis on greenhouse emission



Analysis on greenhouse emission reduction through the cyclic utilization of methane

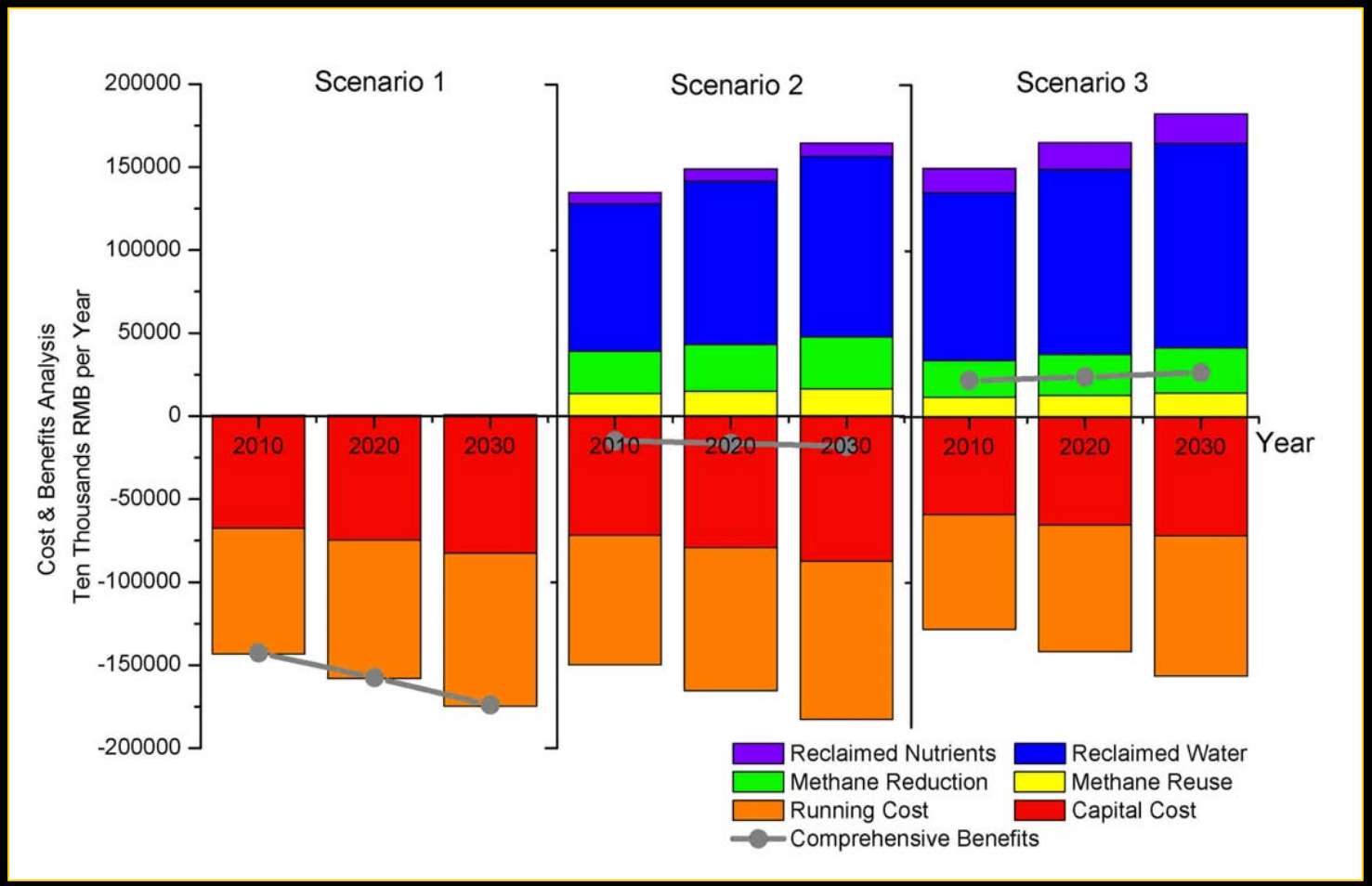


Scenario analysis on the BOD5 of domestic sewage



Scenario analysis on nutrient recycling and increase of grain production

3. Outcomes and analysis



Scenarios analysis of comprehensive cost-benefits

4. Discussion

❖ Greenhouse emission reduction and the mechanism of clean development

---- 35% of inputs for urban sanitation infrastructures--→corresponding problem: shortage of the initiation fund

❖ Valley water pollutant reduction and the impact on the aquatic environment of valleys

---- 77% of inputs of the traditional technological mode--→corresponding problem: shortage of the operation costs

❖ Nutrient recycling and grain safety of certain regions

---- 16% of nutrients required by grain supply--→corresponding problem: grain safety

❖ Sustainable input on the treatment of domestic pollutants

---- RMB 220 million resulting revenues--→corresponding problem: unsustainable input for urban pollution treatment

5. Outcomes and discussion

Bottleneck for the development of ecosan technologies:

❖Shortage of polices, specifications and norms

❖Shortage of the production, construction and service systems

❖Shortage of the R&D, initiation and construction funds

❖Shortage of the technical personnel and the managerial personnel

❖Shortage of the R&D and promotion system

❖Shortage of promotion and education

Deficiencies of the this article and follow-up works

❖Shortage of polices, specifications and norms

❖Shortage of the production, construction and service system

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Deficiencies of the this article and follow-up works

❖The methodology system for analysis of benefits derived from ecosan technologies is yet to improve.

❖Sensitivity study of the scenario analysis shall be carried out.

❖The more complicated ecologic benefit study shall be carried out.

❖Including: the benefits of regional health and increase of employment opportunities.

5. Outcomes and discussion

Conclusions

1. Both the centralized and the decentralized ecosan technology system can greatly reduce greenhouse emission.
2. The decentralized ecosan technology system can reduce difficulty level of domestic sewage treatment.
3. The urban ecosan system has the potential of nutrient recycling.
4. The urban ecosan system can bring about considerable economic benefits.

Thank You!

Your comment is appreciated.
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