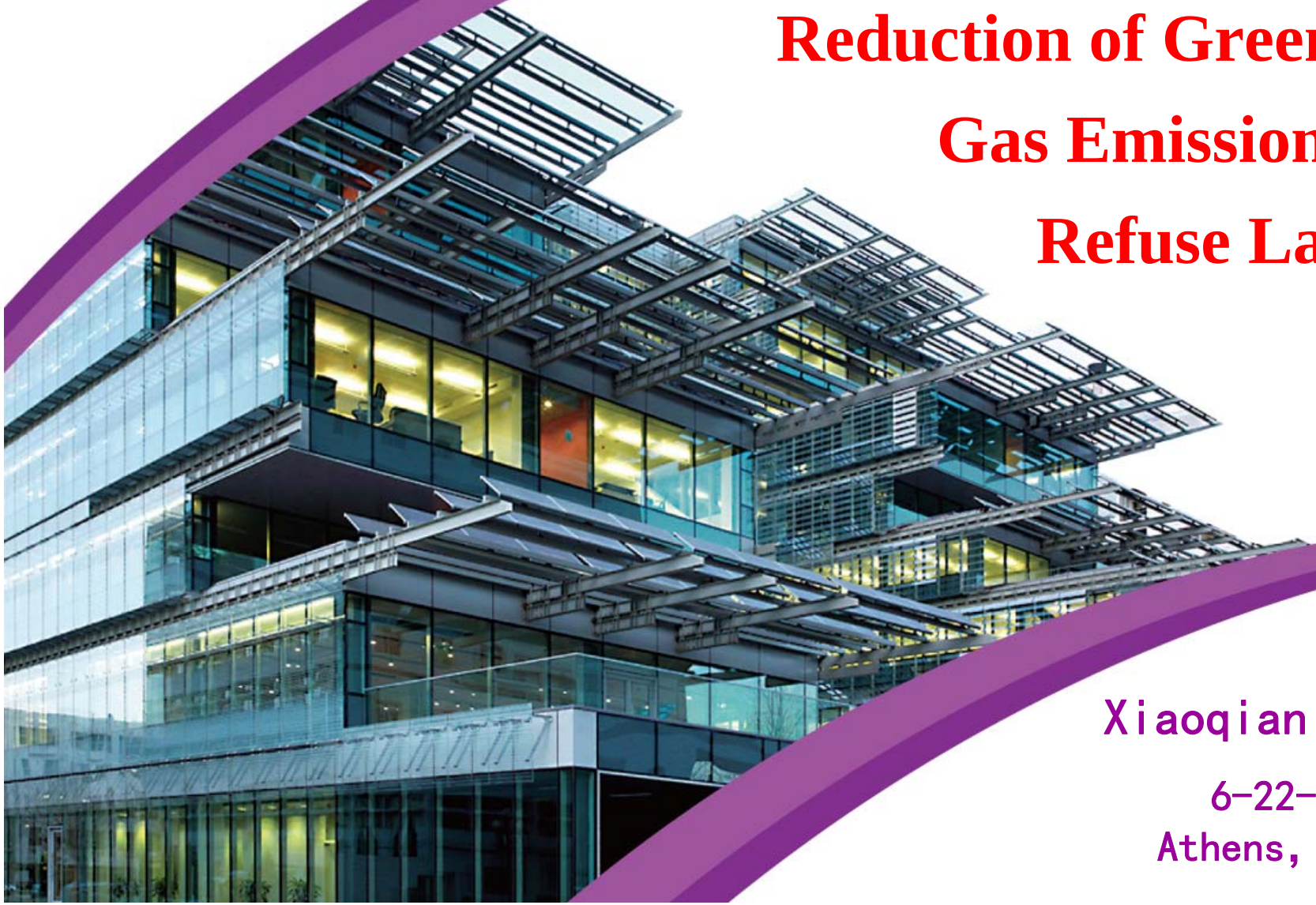
清華大學环境学院
SCHOOL OF ENVIRONMENT, TSINGHUA UNIVERSITY

Systematic Solution for Reduction of Greenhouse Gas Emission From Refuse Landfills



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6-22-2017
Athens, Greece

1. Introduction

MSW properties in China

- Increase in quantities
- Kitchen waste (60%)
- Coal ash
- Non-homogenous

From 0.52 million t/d in 2005 to 1.4 million t/d in 2025.

Kitchen waste makes up the highest proportion of the waste stream.

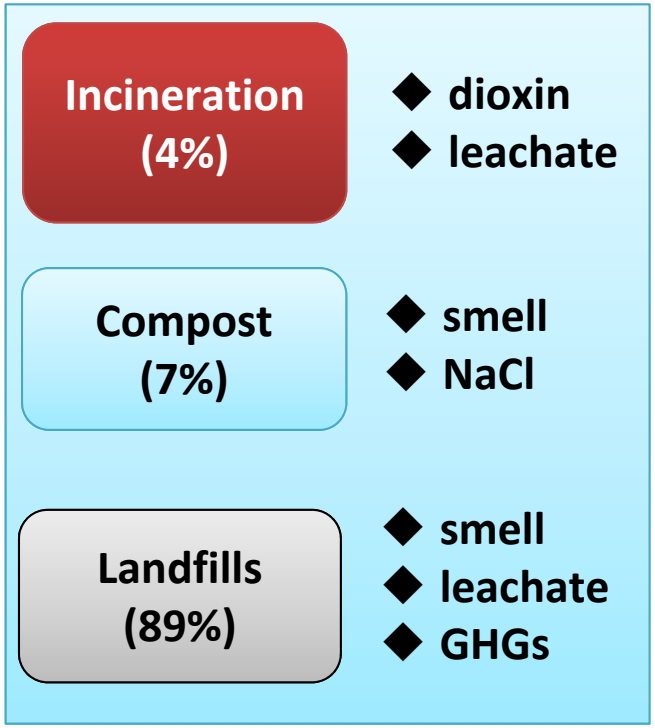
Variation is caused by the level of development and income, consuming habits...

1. Introduction

Traditional MSW treatments

Landfill gas (LFG)

Landfill gas (LFG)



- CH_4
- CO_2
- H_2S
- NH_3
- H_2

Main source of CH4

Potential green energy

Objective: GHGs emission control and LFG utilization

1. Introduction

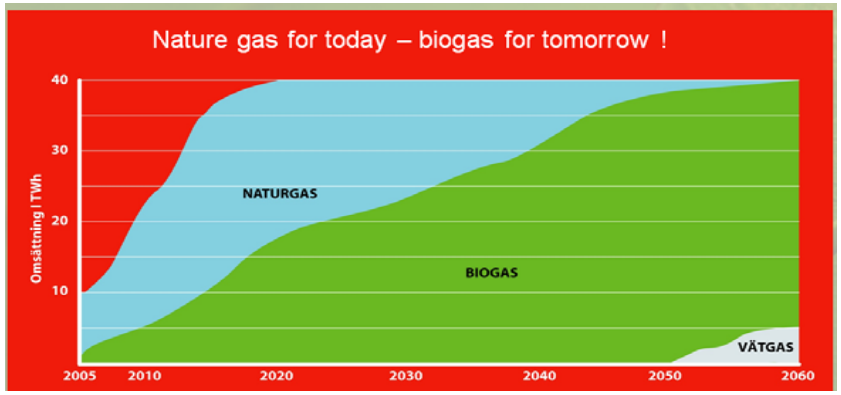
MSW disposal in developed countries

Germany	landfill → LFG → biogas
Denmark	landfill → LFG → biogas
Japan	incineration compost → biogas
Korea	landfill → LFG → biogas

Germany

By 2050, proportion of renewable energy will increase to 80%

Sweden



UK

Ministerial Foreword

We are delighted to announce the publication of the joint Government and Industry Anaerobic Digestion Strategy and Action Plan for England.

The coalition is committed to being the 'Greenest Government ever' and achieving that will in part mean substantially increasing energy from waste through Anaerobic Digestion (AD). This offers a

to help overcome them. This Strategy and Action Plan are the result of this work. Each action has a named lead organisation and all have committed to drive the work forward. Changes cannot be delivered overnight, and the Action Plan may well need to be modified by experience, but this Plan is the first and key step to enabling a thriving AD industry to grow in England over the next few

2. Current situation and existing problems

1、extensive and inefficient collection of LFG

2、limited means of LFG utilization

3、insufficient development of industrial equipment with methane separation technology

collection

- 50-60%
- 40%
- 7%

utilization

- Flare burning
- electricity

equipment

- Rely on imports
- Lack of key technology

2. Current situation and existing problems

The current treating model of LFG:

1、low collection efficiency and level of utilization

&

2、insufficient industrial development

the major restricting factor on the objective of landfill GHG reduction.

3. Systematic solution

3.1 Collection system of GHG

the collection system combined HDPE membrane with horizontal well

during the landfill operation

after landfill closure

coating technology, leachate 3D guide process and vertical collection wells

3. Systematic solution

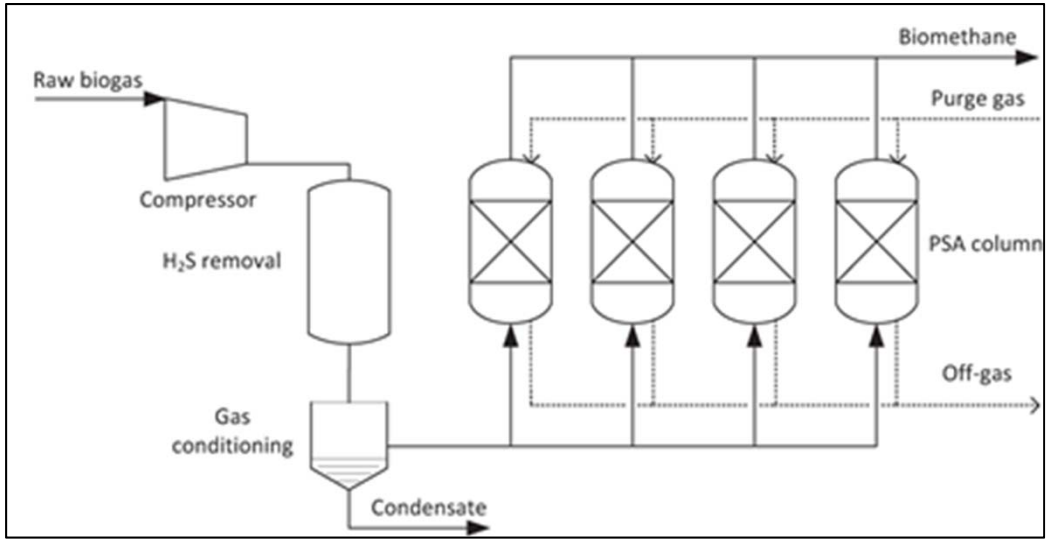
3.2 Optimization of CH_4 separation technology

Comparisons of the characteristics among PSA, water washing, and medical washing

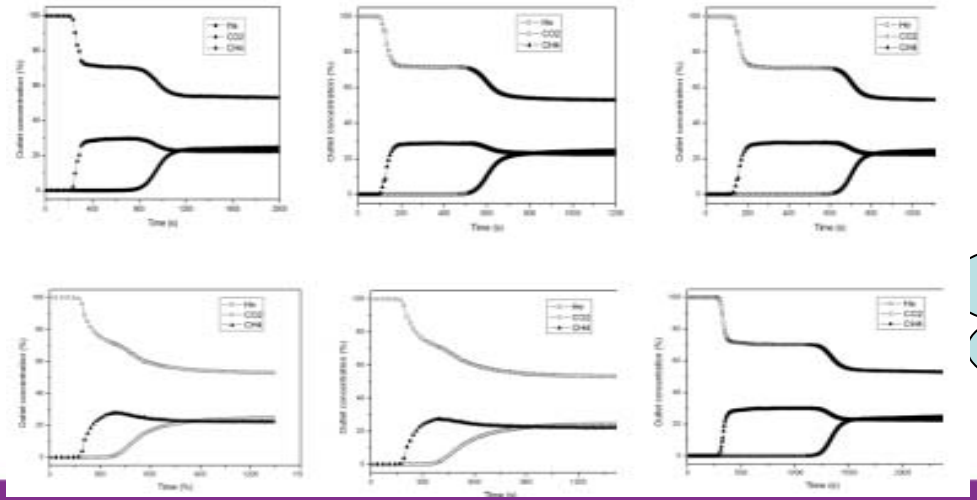
Parameters	PSA	water washing	medical washing
pretreatment of gas	Yes	No	Yes
operation pressure (bar)	4-7	4-7	No
chemical agent	No	No	Yes
CH_4 yield of products	>96%	>97%	>99%
energy consumption (kWh/Nm^3)	0.25	<0.25	<0.15
recovery of CH_4	medium	high	high
heat	no	no	Yes (160 ° C)

3. Systematic solution

3.2 Optimization of CH_4 separation technology



adsorbent



The separation factor of CH4/CO2 mixture gas was up to 9.55

3. Systematic solution

3.3 skid-mounted equipment for LFG upgradation

integrated equipment in Guizhou

Stage 1
scale : 20000 Nm^3/d
technology : PSA

Stage 2
scale : 24000 Nm^3/d
technology : PSA

Stage 3
scale : 20000 Nm^3/d
technology : PSA

Stage 4
scale : 10000 Nm^3/d
technology : membrane

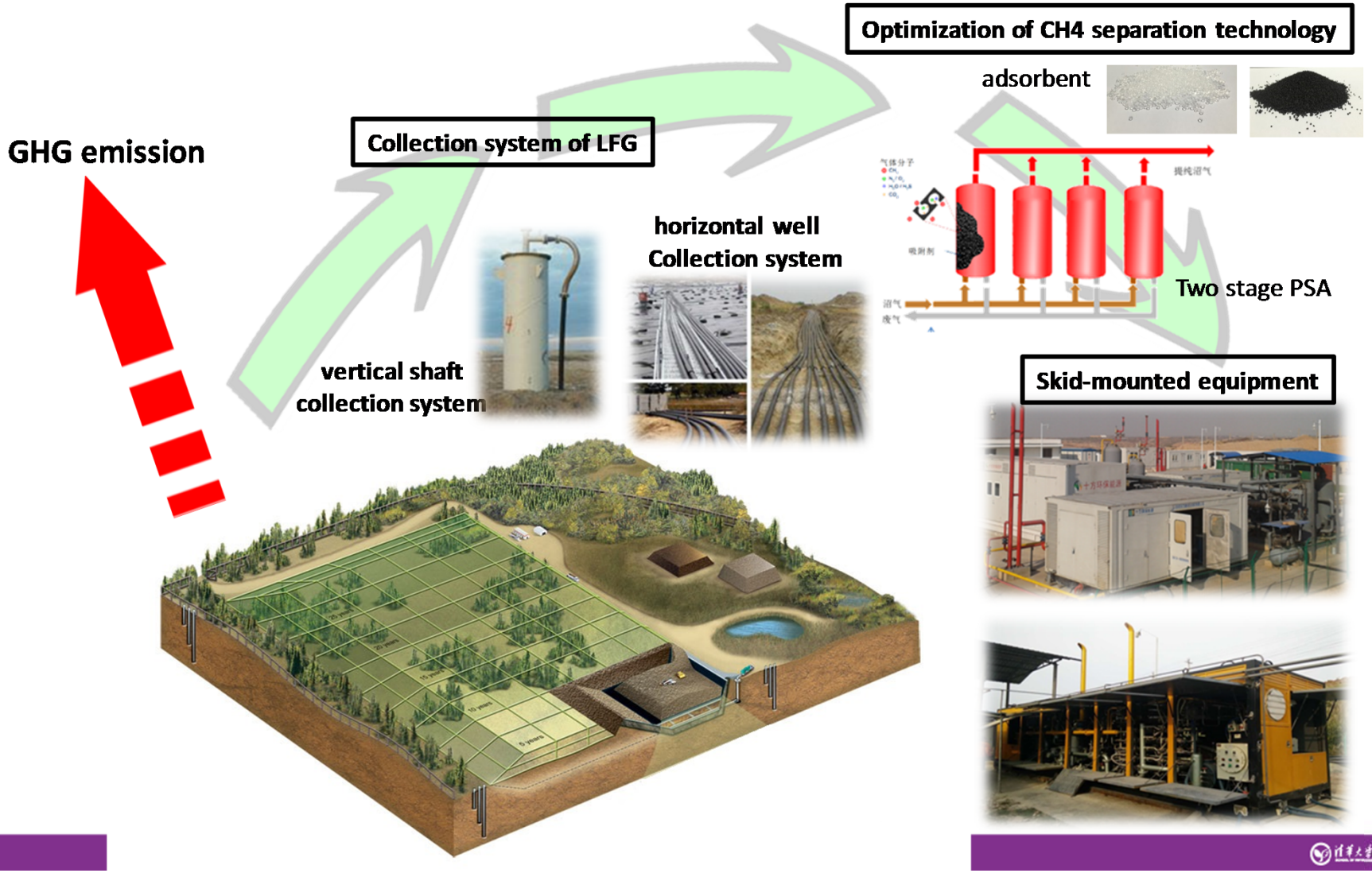
Adsorbent optimizaiton

Reduced area

Integrated equIpments

4. Conclusions

The whole process systematic solution of efficient collection – purification and upgrading – resource utilization



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THANKS !

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