



# **Bio-methane production and energy conversion by anaerobic digestion of organic waste**

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**Korea Environment Corporation**

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# Korea Environment Corporation

## Who We Are

*Closer to Nature, Closer to People*

**Establishment** January 1st, 2010

**Classification** Semi-governmental organization

**Organization** 5 headquarter head offices,  
6 local regional headquarters,

**Human Resources** About 2,000 staff members  
/ environmental experts

**Mission** A coexistence between mankind and nature  
; K eco opens the future of environment

**Vision** Establishment of healthy and happy environment  
for the nature and human beings



# Korea Environment Corporation

## | What We Do

### Climate & Air

- GHG reduction policy support
- Reinforcement of capacity for climate change response
- Management of ambient air quality & environment
- Management of vehicle environment

### Environmental Health

- Promote of life-based environmental services
- Provision of environmental public health service
- Management of Hazardous Material
- Prevention of reduction of pollutant discharge

### Water & Soil

- Water and sewage policy support
- Soil and underground water management
- Water pollution management and control

### Environmental Infrastructure

- Installation support of aquatic ecology restoration and water treatment facility
- Installation and operation of water and sewage facility
- Installation and support of environmental energy recovery facility
- Expansion of international business

### Resources Recirculation

- Resource circulation program
- Operation and management of resource circulation system
- Waste management



# Issues & Challenges - Waste / Waste-to-Energy

## Waste to Energy Technologies

### Incineration & cogeneration

Replacement of fossil fuel, Energy production



### Organic Waste-to-Energy

Bio-gasification of organic waste

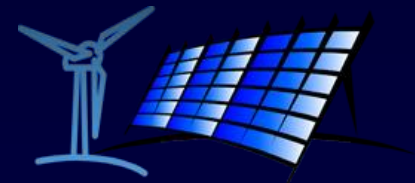


### Eco-friendly Energy Town

Bio gas  
(Methane)



Renewable  
Energy  
(Wind, Solar)



Tourism  
connection



# Organic waste

## Definition

- ✓ Be produced wherever there is human habitation
- ✓ The amount of organic waste produced is increasing dramatically each year

## Main forms



Livestock manure



Household food waste



Forest waste



Sewage sludge

## Potential

- ✓ Very high as useful resources and for making energy

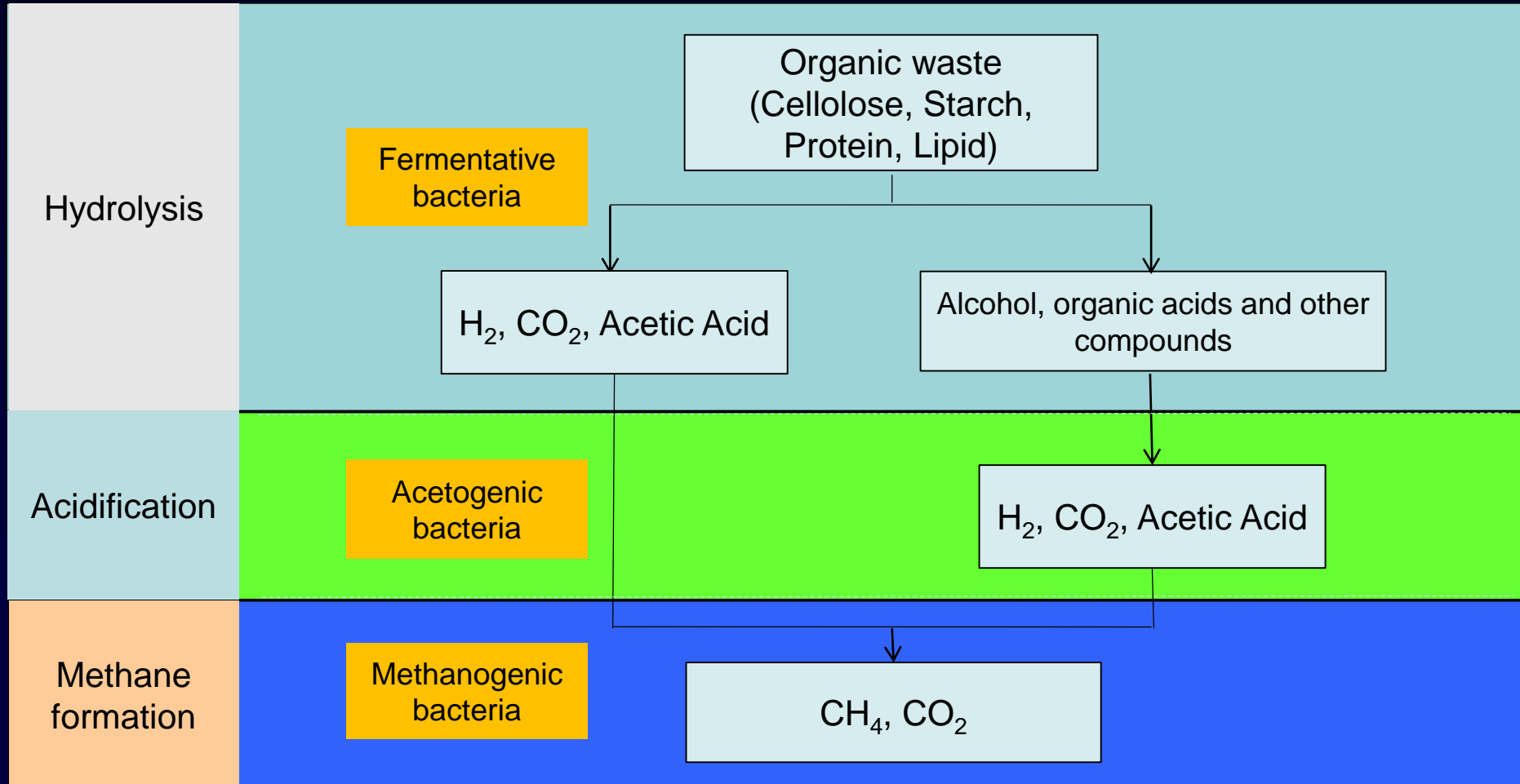
## Treatment

- ✓ Anaerobic digestion, Composting, Animal feed etc

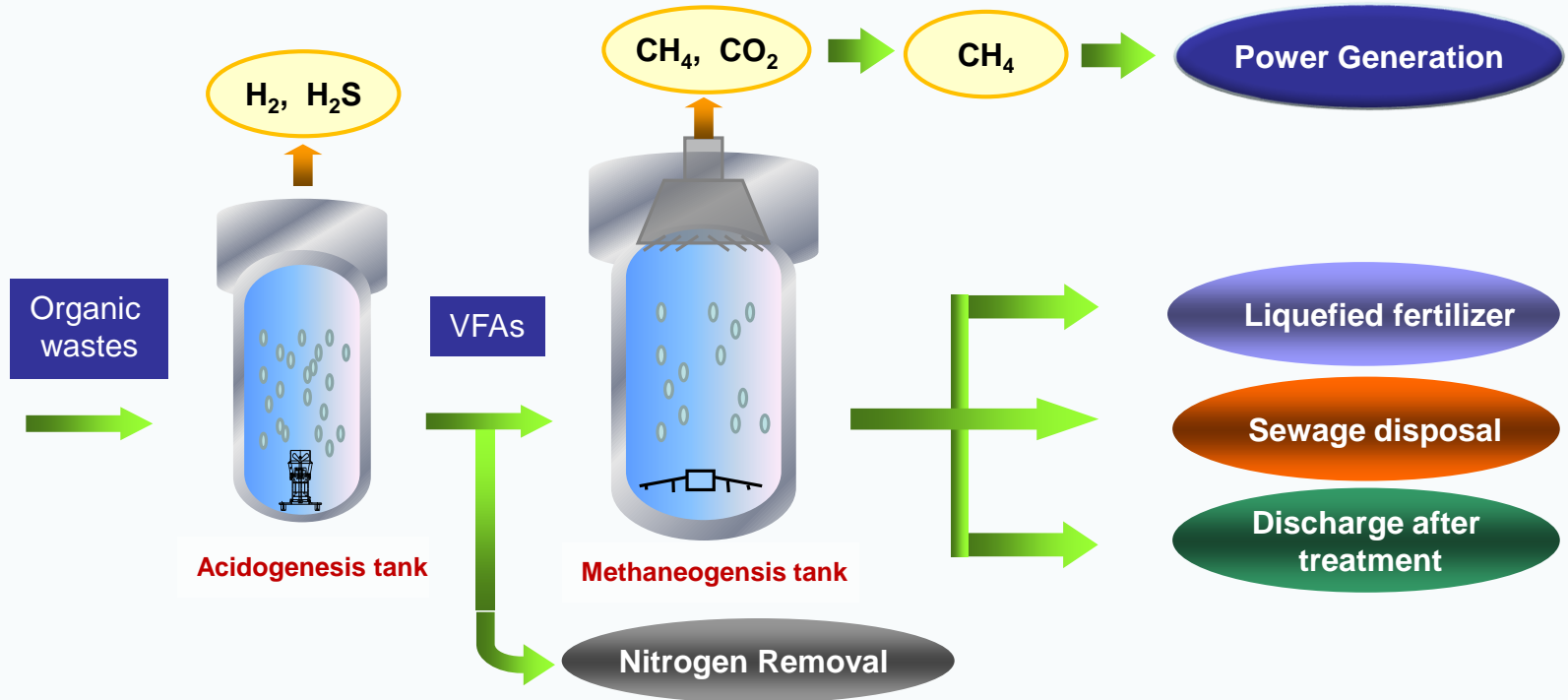
# Anaerobic digestion process

## Basic process

- The three stage anaerobic digestion of organic waste



# Anaerobic digestion process



- Biogas :  $CH_4$  (55~65%),  $CO_2$  (35~45%) etc
- Caloric Value : Biogas gas - 4,500~5,500kcal/m<sup>3</sup>,  $CH_4$  - 10,500kcal/m<sup>3</sup>
- Use : Biogas power plant, Vehicle fuel(CNG)



# Co-digestion

- ✓ In the past, anaerobic digestion was single substrate and single purpose treatment
- ✓ Recently, co-digestion of two or more substrate and multi-purpose

- **Two or more substrate**

: Major amount of a main basic substrates + Minor amount of a single or a variety of additional substrates

👉 **Improved nutrient balance and digestion performance**



Livestock manure

- ✓ High pH(>8)
- ✓ High alkalinity
- ✓ High ammonia density
- ✓ High moisture content(>95%)
- ✓ Low organic matter



Food waste

- ✓ Low pH(<4)
- ✓ Low alkalinity
- ✓ High salt
- ✓ High organic matter
- ✓ High biodegradable



Sewage sludge

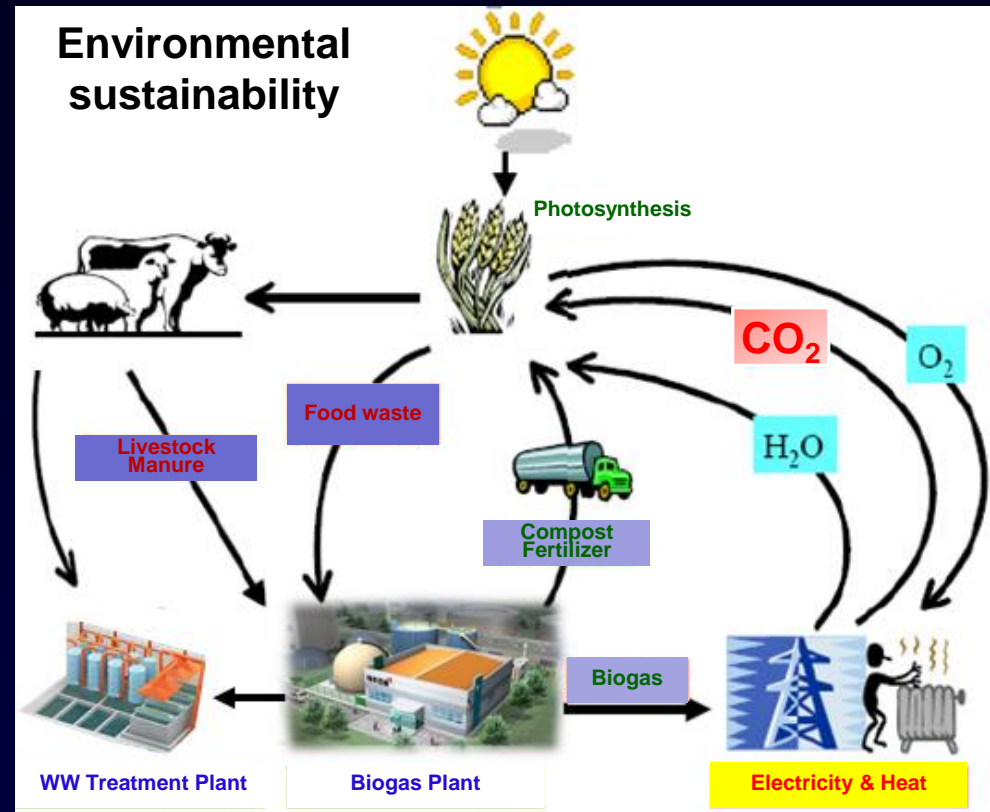
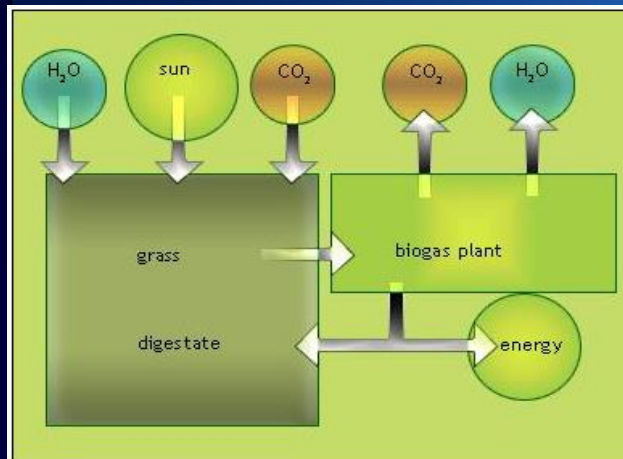
- ✓ Neutrality of pH
- ✓ High organic matter
- ✓ Low biodegradable
- ✓ High moisture content



# Contribution to the Environment

## Food Waste (100 Ton/d) Effect of biogasification

- $\text{CH}_4$  production  
= 2,600,000  $\text{m}^3/\text{Y}$   
= 22,200 Gcal/Y
- $\text{CO}_2$  reduction  
= 39,000 Ton/Y



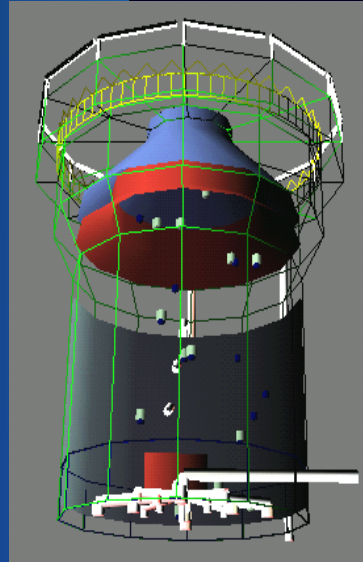
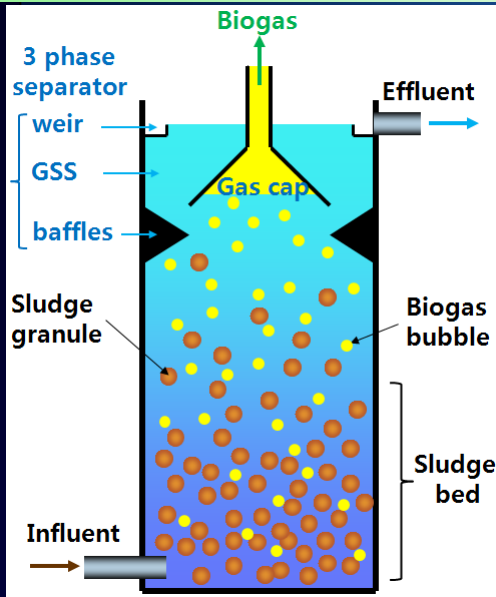
- ✓ Carbon neutral & Substitution of fossil fuel & Material circulation
- ✓ Reduction of ocean pollution
- ✓ Production of energy in contrast to aerobic treatments
- ✓ Protection and improvement of the local environment
- ✓ Increase of the energy independence in the provinces

# Biogas plant treating 100 ton/d of food waste and sludge in Song-do, Incheon, Korea

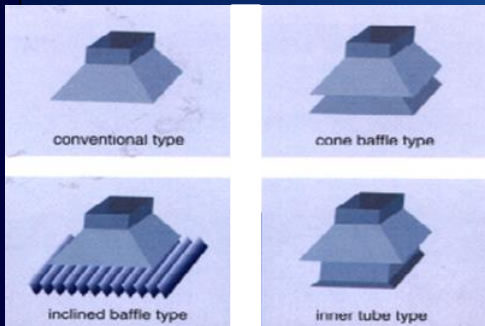


# Wet Digestion (UASB) Technology

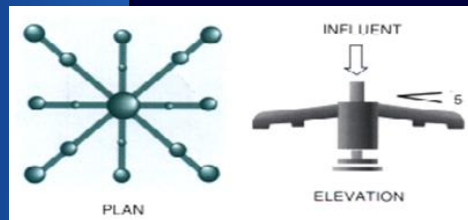
## Methane Fermenter Structure



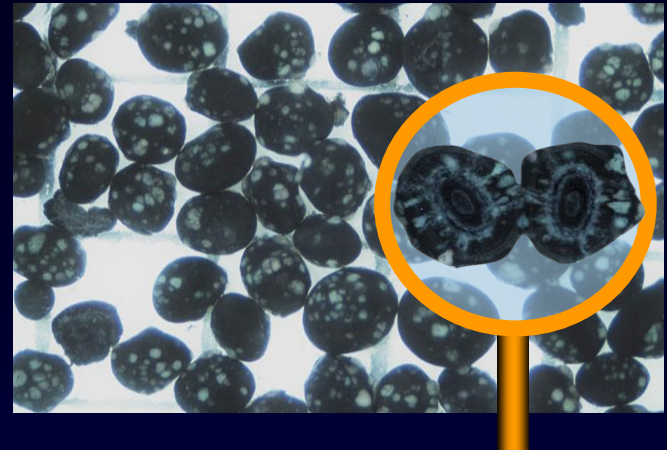
## GSS (Gas Solid Separator)



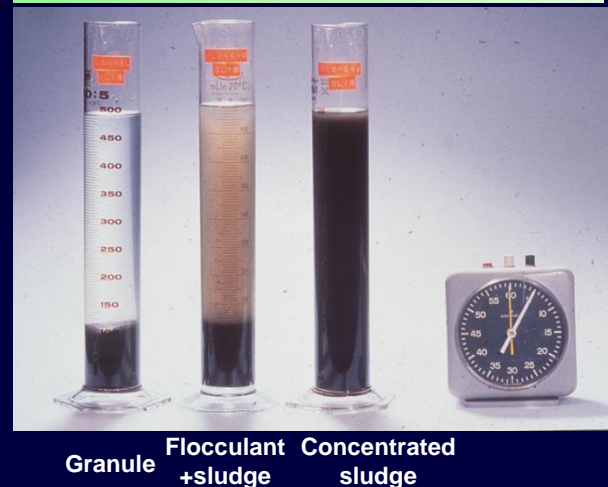
## Distributor of Influent



## Granule



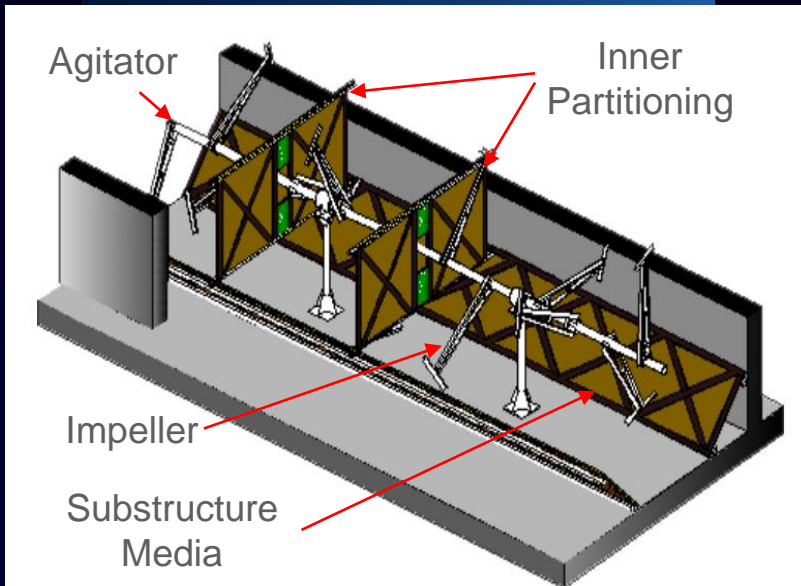
## Sedimentation Property



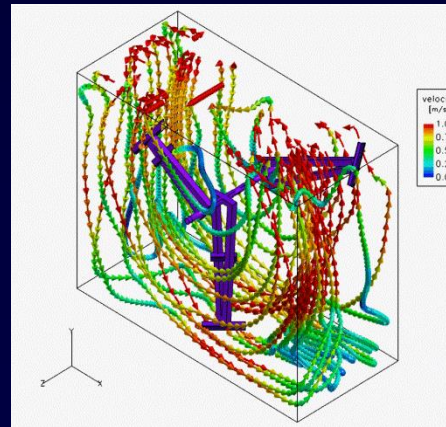
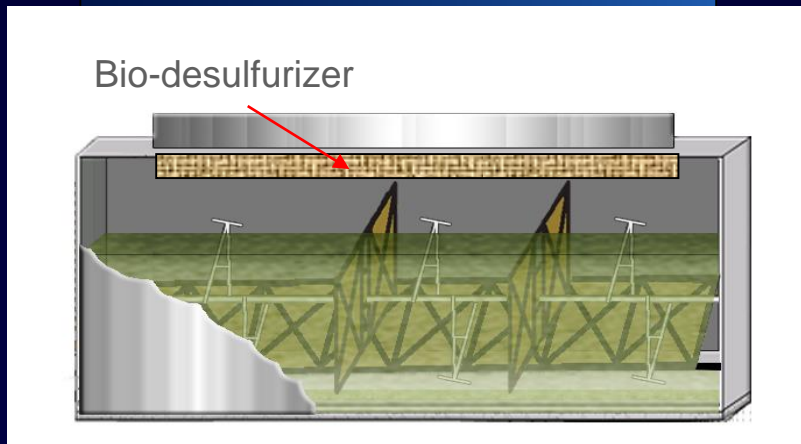


# Semidry-type Horizontal Digester

(KH-ABC)



- High organic loading: over 3.5~4 kgVS/m<sup>3</sup>/d
- Maximizing biogas production : over 0.6 m<sup>3</sup>/kg VS<sub>rem</sub> (over 100 Nm<sup>3</sup>/Ton of Food waste)
- Efficient mixing with vertical type impeller: remove scum and prevent sludge sedimentation
- High digestion efficiency by plug-flow digestion
- Internal equipment for biological desulfurization
- Equipments for sludge removal and return
- Microorganism enrichment; Recycle and enrichment
- Easy and low-cost maintenance





# Biogas plant treating 320 ton/d in Seo-san, Chung-nam, Korea (Under construction)

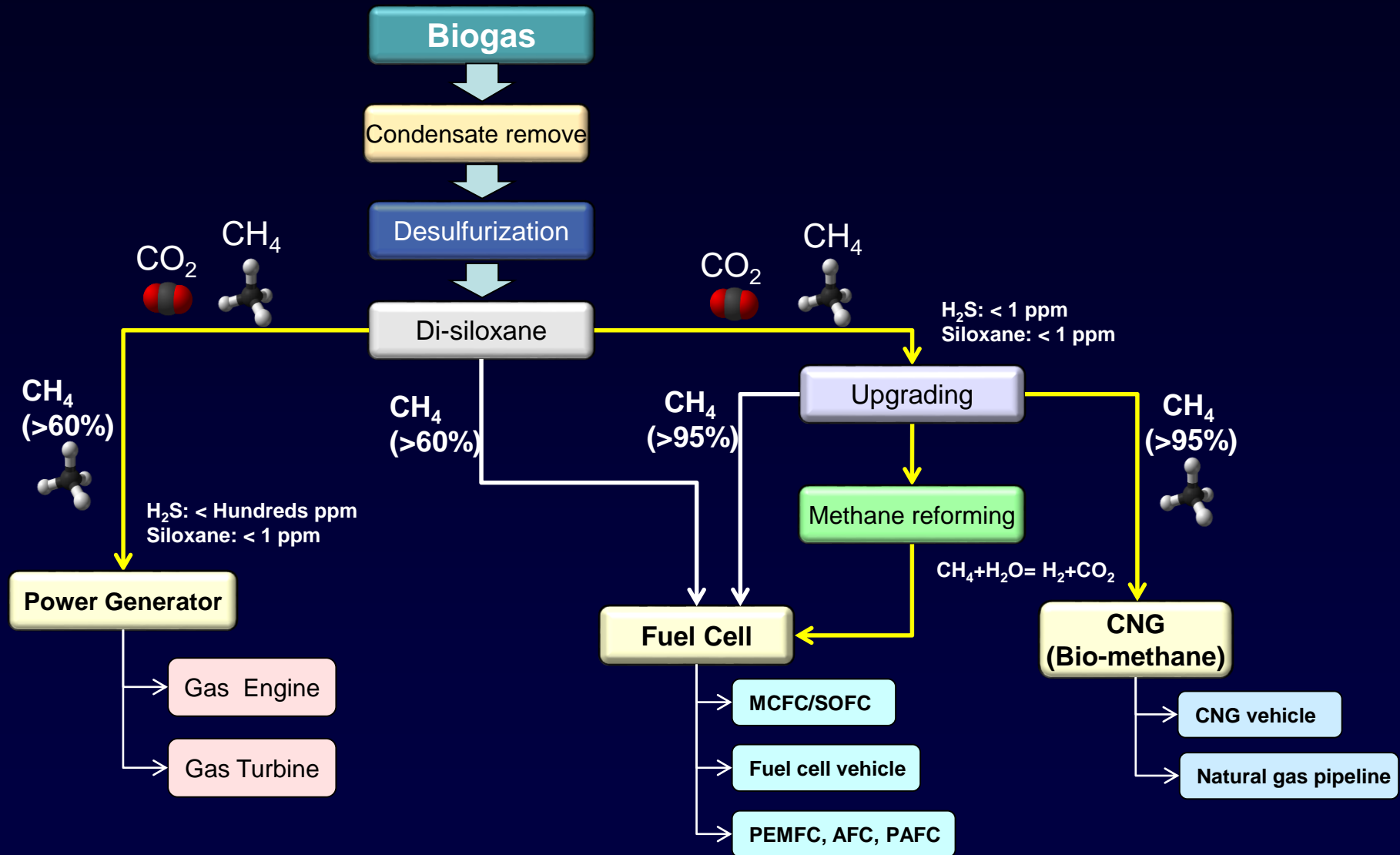
Organic  
w a s t e  
t o b e  
t r e a t e d

- Livestock manure : 100 ton/d
- Night soil : 70 ton/d
- Food waste : 50 ton/d
- Sewage sludge : 100 ton/d

KH-ABC Anaerobic digester

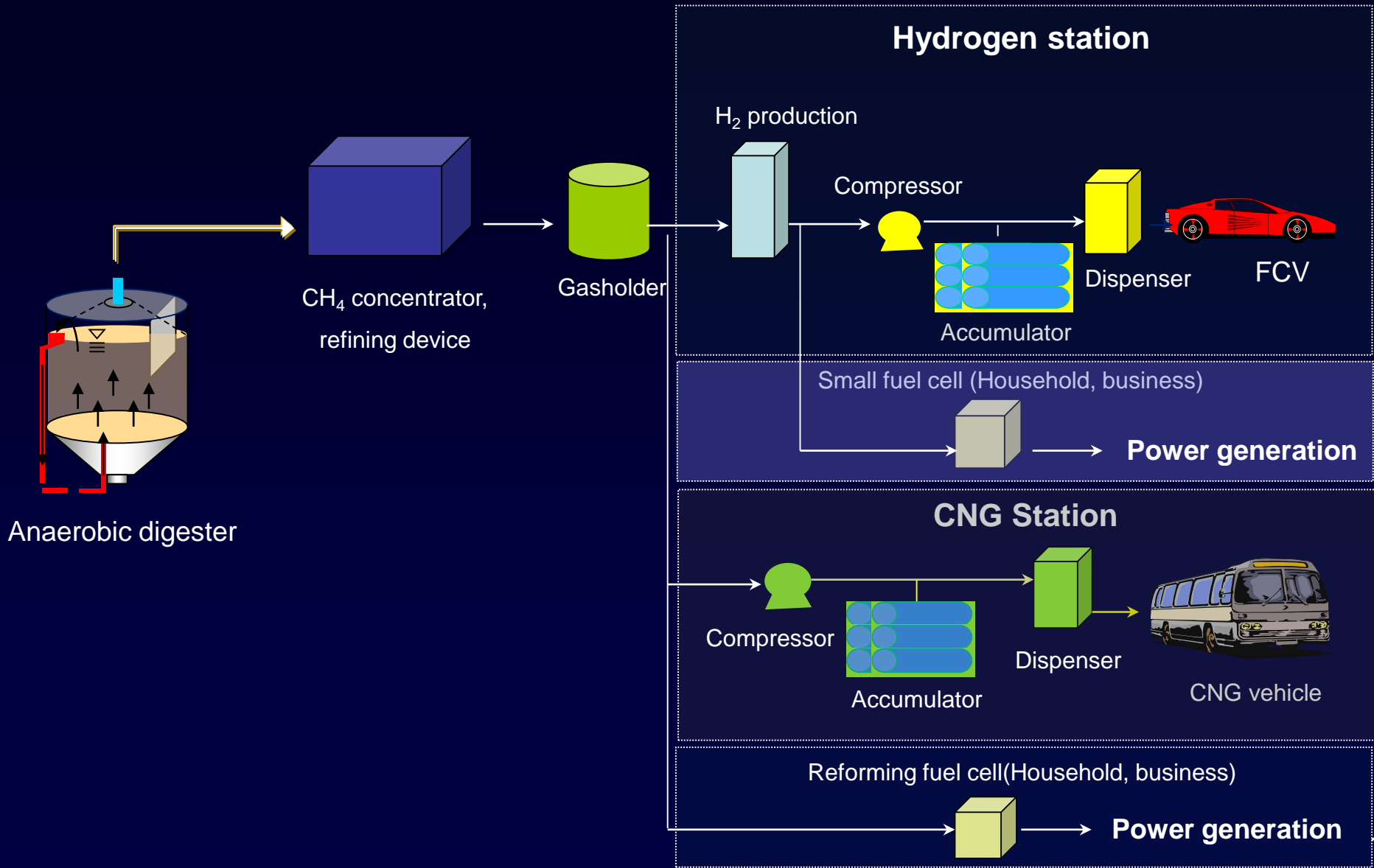


# Bio-gas refine process

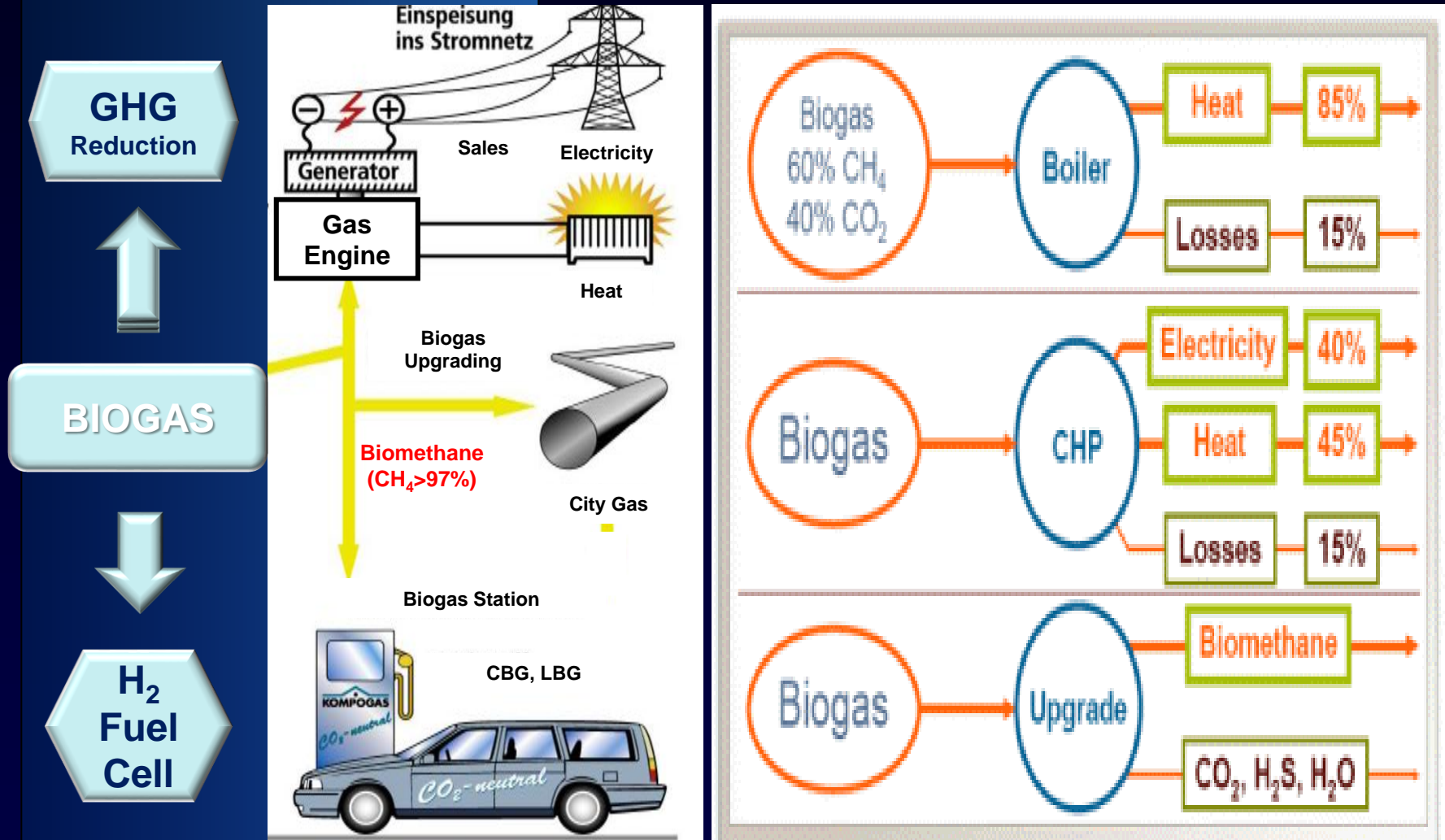




# Bio-gas refine process



# Utilization of Biogas & Biomethane



# Case study of anaerobic digestion



Ichon, 20 Ton/d, Swine WW, 2005



Songdo, 200 Ton/d, Food WW, 2006



Asan, 100 Ton/d, Manure+Sludge+Food, 2008



Muju, 50 Ton/d, Swine WW, 2009



Boseong, 60 Ton/d, Manure+Food, 2010



Jeongup, 50 Ton/d, Swine WW, 2010



Jangsoo, 150 Ton/d, Swine WW, 2011



Daegu, 300 Ton/d, Food waste, 2012



Incheon, 100 Ton/d, Food +Sludge, 2013

# “ The Butterfly Effect ,,”



“Small changes make a big revolution”

**Thank you~!**



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