



GREEN
ENERGY
NETWORK



www.greenenergynet.net



Our Expertise and Fields of Services

- Renewable Energy Projects Development
- Biogas Technologies & Biogas Power Plants
- **Biogas upgrading & Biogas Utilization**
- Biomass Power Plants
- Wastewater Treatment Plants (Organic & Chemical Wastewater) for Domestic & Industries
- Potable / Service Water Plants / RO-Demineralized Water Plants
- Utilities Structural Works, e.g. Substation, Warehouses, Etc.

Our Services

- Turnkey EPC (Engineering, procurement and construction) Projects
- Design, Engineering & Consultancy Services
- Owner Engineering Service, Lender Engineering/ Independent Engineering Services
- O & M Services
Project Development, BOT or BOOT (Build, Own, Operate, Transfer)



องค์ประกอบทั่วไปของก๊าซชีวภาพ

- Methane (CH_4) ; 50 - 65%
- Carbon Dioxide (CO_2) ; 25 - 40%
- Other (N_2 , H_2S , ไอน้ำ) ; < 5 - 10%

ชนิดของน้ำเสีย	ค่าเฉลี่ย H_2S (PPM)
ฟาร์มสุกร	2,000 – 4,000
น้ำมันปาล์ม (POME)	2,000 – 3,000
เอทานอล (อ้อย)	10,000-20,000
โรงงานแปรรูปอาหารทะเล	8,000 – 10,000





ความจำเป็นในการปรับปรุงคุณภาพก๊าซชีวภาพ

- ยืดอายุการใช้งานของอุปกรณ์ผลิตพลังงาน เครื่องยนต์ผลิตกระแสไฟฟ้า
- ควบคุมมาตรฐานคุณภาพของไอเสียจากปล่องเครื่องยนต์ อุปกรณ์เผาไหม้ ให้ผ่านเกณฑ์มาตรฐาน สวล.

(ประกาศของกระทรวงอุตสาหกรรม ค่า Stack Emission: SO_x)

- ป้องกันอันตรายจากการใช้งานอุปกรณ์ที่ถูกกัดกร่อนโดย H_2SO_4





- การเกิดของ H₂S และการเปลี่ยนเป็น H₂SO₄

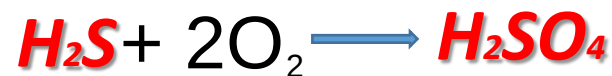
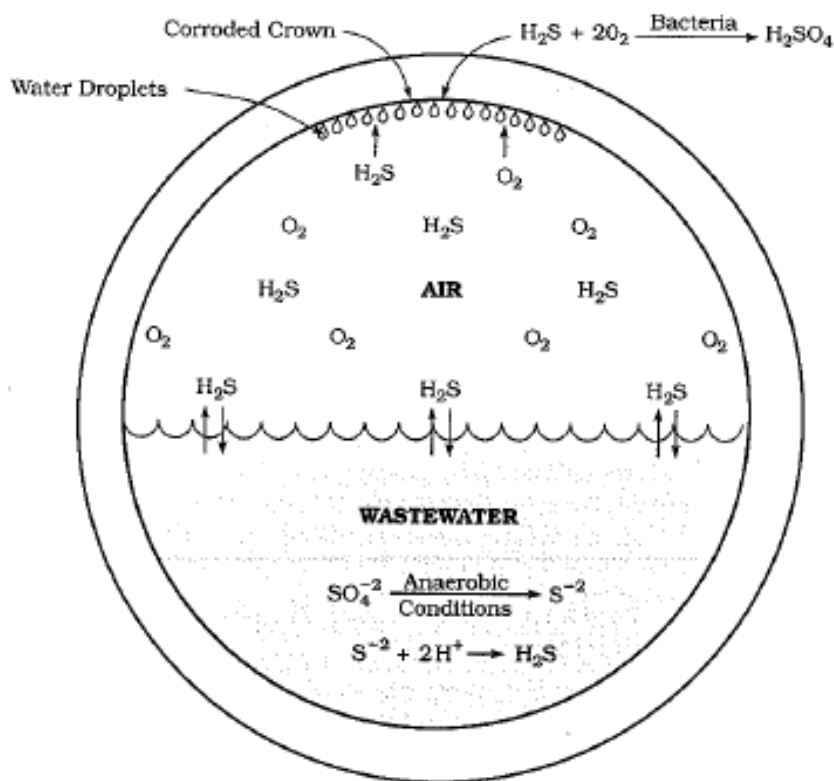


FIGURE 5.1 Anaerobic Conditions in a Sanitary Sewer

Adapted from *Chemistry for Environmental Engineering* by C. N. Sawyer, P. L. McCarty, and G. F. Parkin, 4th. ed. Copyright © 1994 by McGraw-Hill, Inc. Reprinted by permission.





H₂S Scrubber Unit (Biological Process)

Thiobacillus Bacteria is an absorber/media converts the H₂S to elemental sulfur (S₈). Treated outlet gas can readily meet a less than 100 ppm H₂S specification (typical requirement for biogas) or as low as 5 ppm.

The biological sulfur slurry produced may be used for agricultural purposes or purified to a high quality (99%+) sulfur cake.



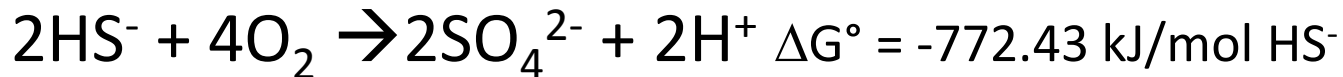
*Theobacillus bacteria and sulfur nodules
(nodules indicated by arrow)*



Method to remove sulfides from biogas (H₂S Bio-scrubber Technology)

Microaeration: Injection of oxygen or air to liquid content

- Biotic oxidation of sulfides



- Sulfur bacteria (*Thiobacillus, ferrooxidans, Beggiatoa, Thiothrix, etc.*), Chemoautotroph
- Use reduced inorganic sulfur compounds as electron donors and CO₂ as C-source



Advantage from using H₂S Bio-scrubber

- **Reduce corrosiveness of gases** and condensates,
- **Low operating cost**, compared with chemical process and ferrous adsorbent process,
- **Provide biogas qualities to be complied with engine warranty** terms and conditions ($\text{H}_2\text{S} < 100 \text{ ppm}$),
- **Extend lifetime of engine parts**, valves and other gas contacting parts, extend service/operating hours of engine's lubed oil, spark plug, etc.,
- **Provide low SO_x emission from combustion of biogas**, lower than the stack emission standard ($\text{SO}_x < 60 \text{ ppm}$)
- **Provide safety, low risk of gas valve leakage and explosion** (from cases of biogas boiler explosions)





H₂S Bio-Scrubber System

- ❶ Use bacteria to reduced H₂S in biogas
- ❷ Flow range 50 - 3,000 m³/hour
- ❸ H₂S inlet 3,000-30,000 ppm
- ❹ H₂S outlet less than 100-150 ppm

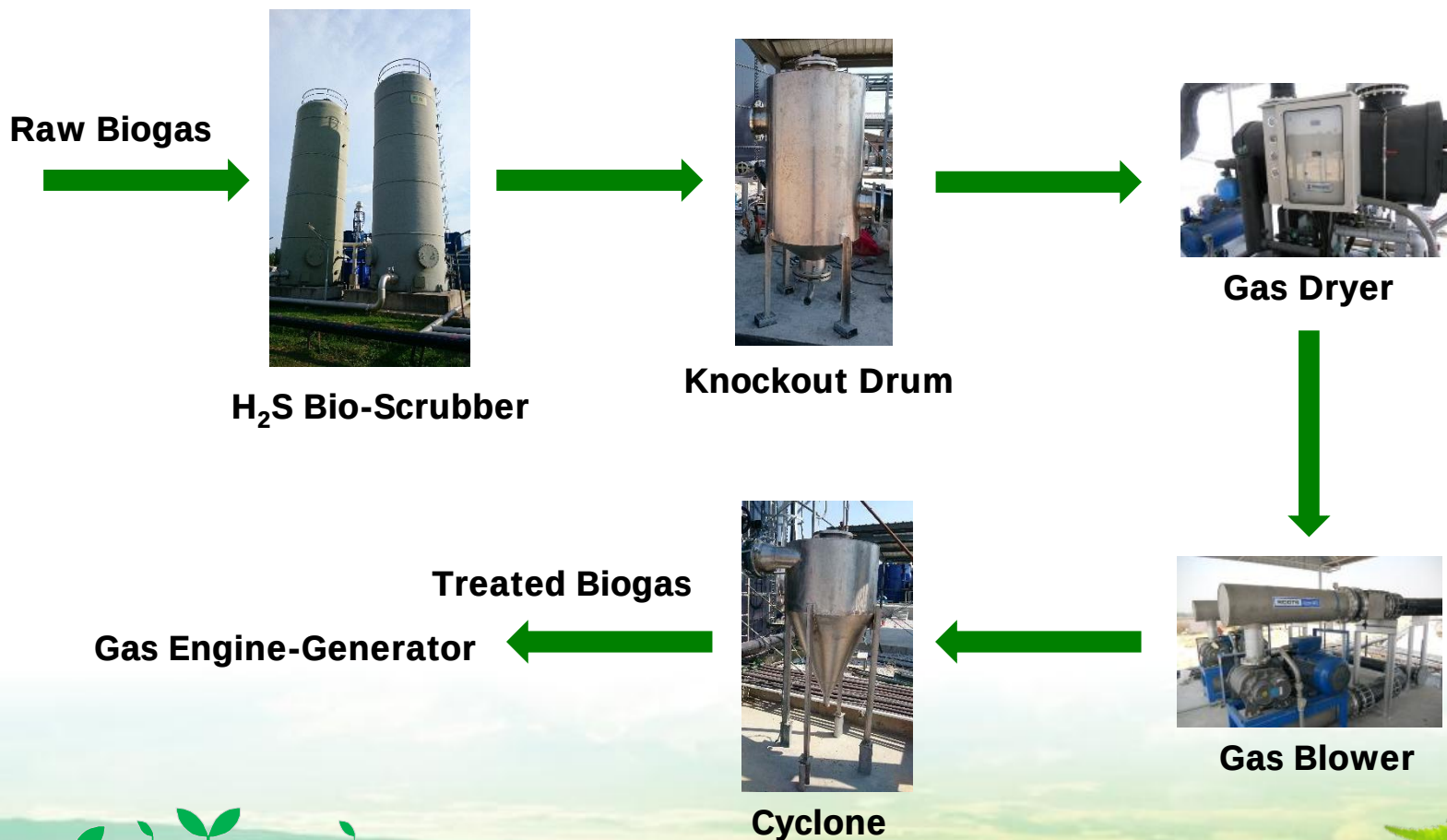


Thiobacillus Bacteria and sulfur nodules (arrow).





Biogas Upgrading (H₂S Gas Removal) and Biogas Utilization System



PRODUCTS By “Green Energy Network”

BIOGAS UTILIZATION EQUIPMENT CAPACITY

Gas Engine Generator (MW)	Biogas Flow (m ³ /hr)	Gas Dyer Type	Flare Type	H ₂ S Scrubber	
				Inlet gas (ppm)	Outlet gas (ppm)
0.5	250	AIR COOLED	OPEN/ENCLOSED		
1	500	WATER/ AIR COOLED	OPEN/ENCLOSED		
1.2	600	WATER/ AIR COOLED	OPEN/ENCLOSED		
1.4	700	WATER/ AIR COOLED	OPEN/ENCLOSED		
1.5	750	WATER/ AIR COOLED	OPEN/ENCLOSED		
1.8	900	WATER/ AIR COOLED	OPEN/ENCLOSED	3,000-15,000	< 100 - 200
2	1,000	WATER/ AIR COOLED	OPEN/ENCLOSED	ppm	ppm
2.4 (1.2 MW x 2)	1,200	WATER/ AIR COOLED	OPEN/ENCLOSED		
3.0 (1.5 MW x 2)	1,500	WATER/ AIR COOLED	OPEN/ENCLOSED		
3.6 (1.2 MW x 3)	1,800	WATER/ AIR COOLED	OPEN/ENCLOSED		
4.0 (2 MW x 2)	2,000	WATER/ AIR COOLED	OPEN/ENCLOSED		

Remarks: The presented biogas utilization unit model is for reference only. The final detailed design shall be revised and finalized according to each special requirement.



Biogas Utilization System



GAS DRYER

Gas dryer is a gas dehumidification unit, using shell-and-tube heat exchanger, equipped with chillers, providing chilled water to cool down biogas until moisture in biogas condensed into liquid condensate, and taken out.



BIOGAS BLOWER

We supplies biogas blowers, using for boosting gas pressures to meet widely range requirements of gas burner and gas engine. Our Biogas Blower is well & proven in design and manufacturing, which its vertical structure that has suction side at the top and discharge side at the bottom, can prevent any accumulation of corrosive matter inside the casing. High quality material with optional anti-corrosion coating, such as, Teflon is used for blower's gas contacting parts for reliable and less maintenances.



BIOGAS FLARE

Biogas Flare Systems are designed to perform duties regarding to the highest industrial standards (Enclosed and open type) of safety, high durability of use, and high combustion efficiency.

PRODUCTS

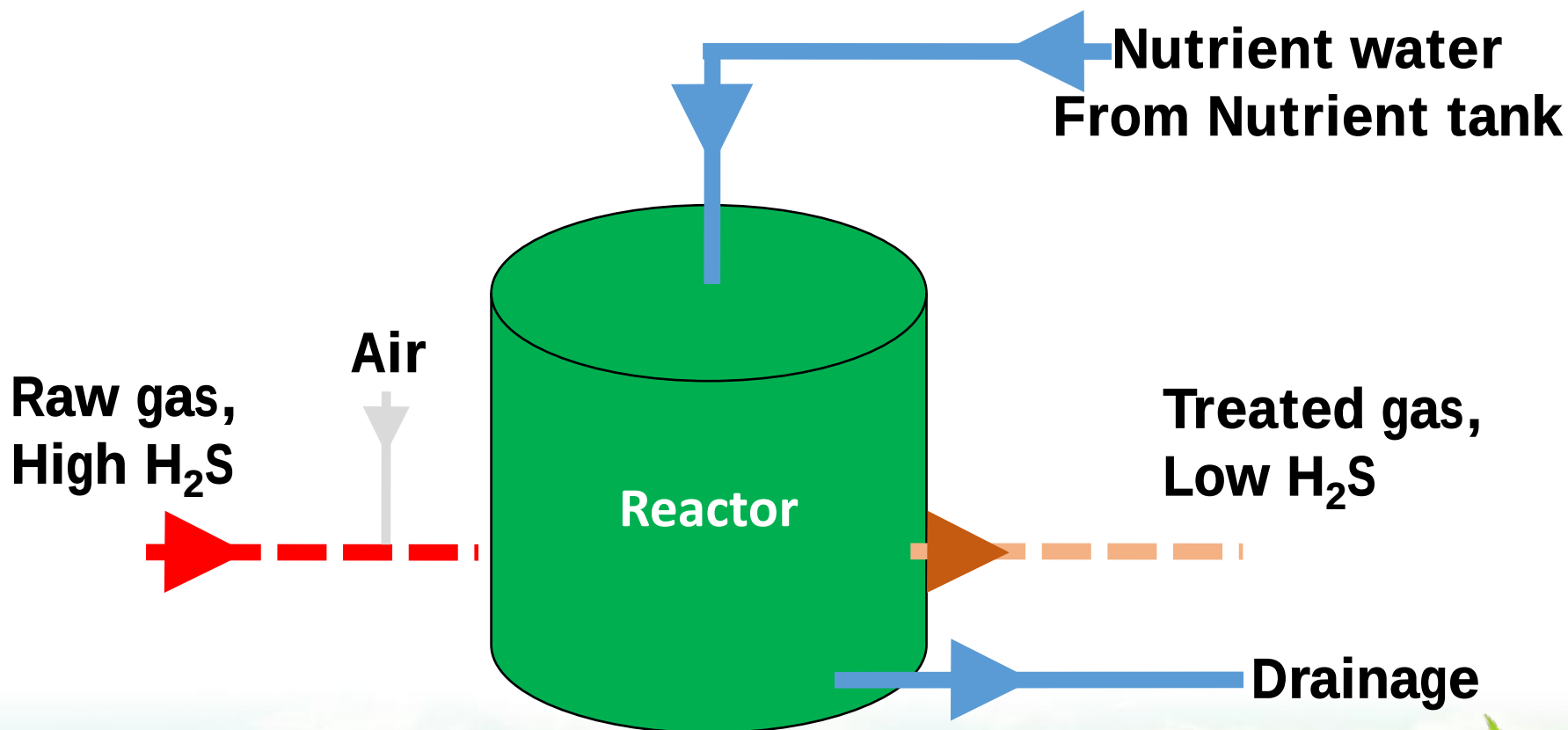
***By
“Green
Energy
Network”***



H₂S Bio-Scrubber System



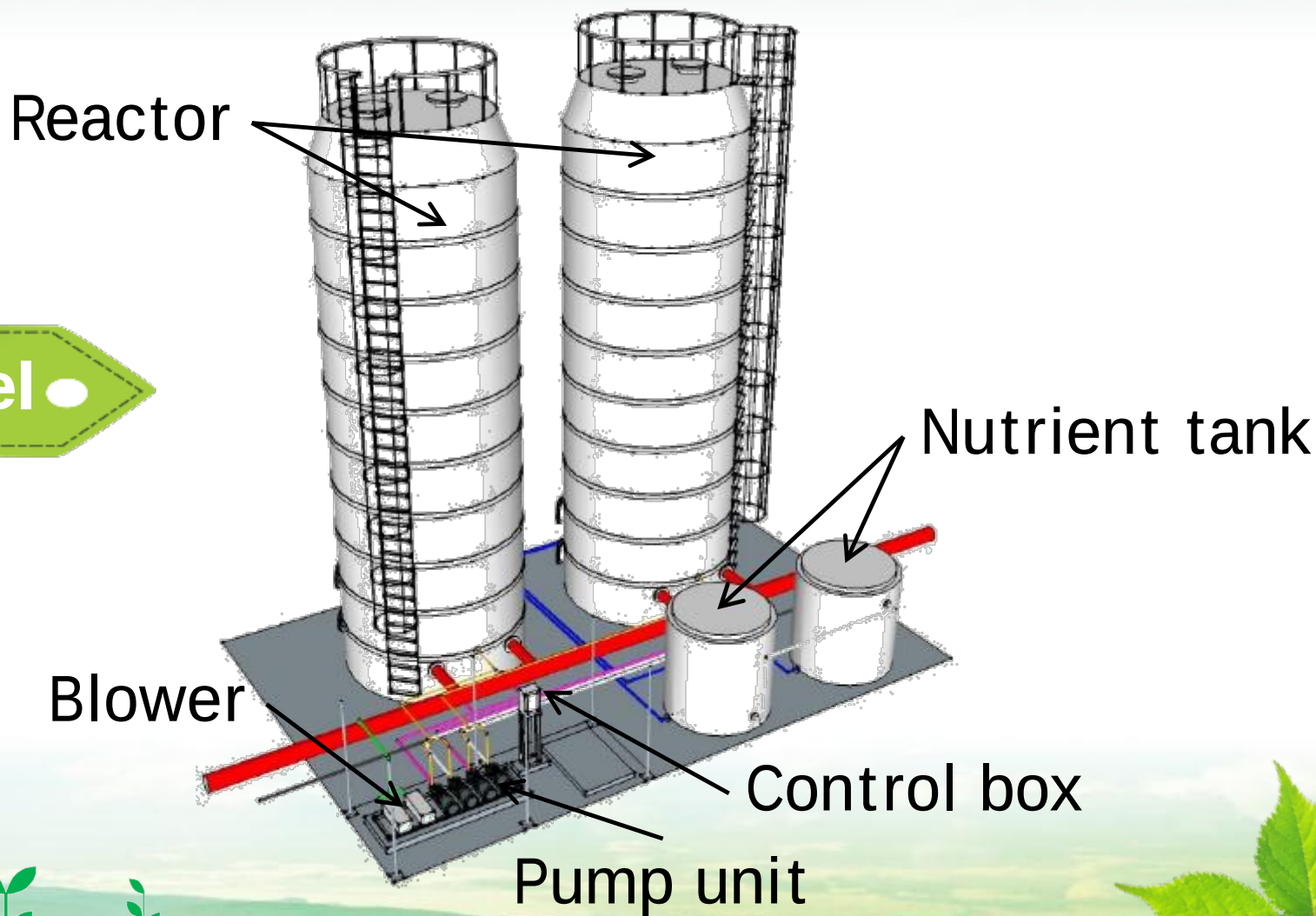
H₂S Bio-Scrubber Unit Schematic



Process flow of H₂S bio-removal unit



H₂S Bio-Scrubber System

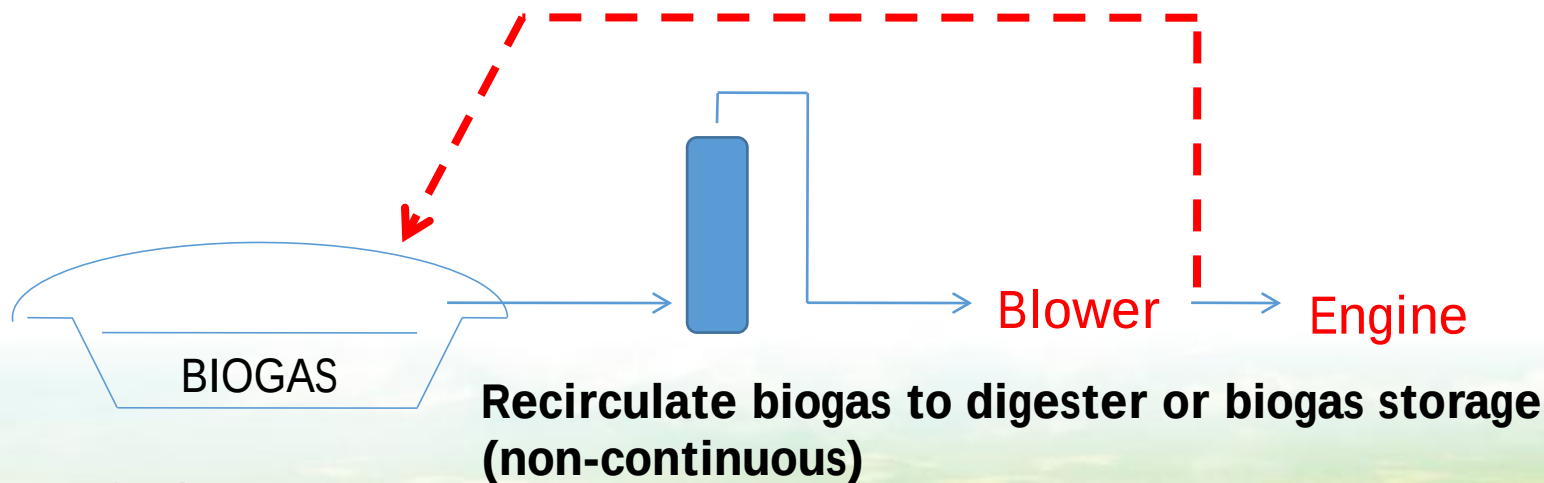
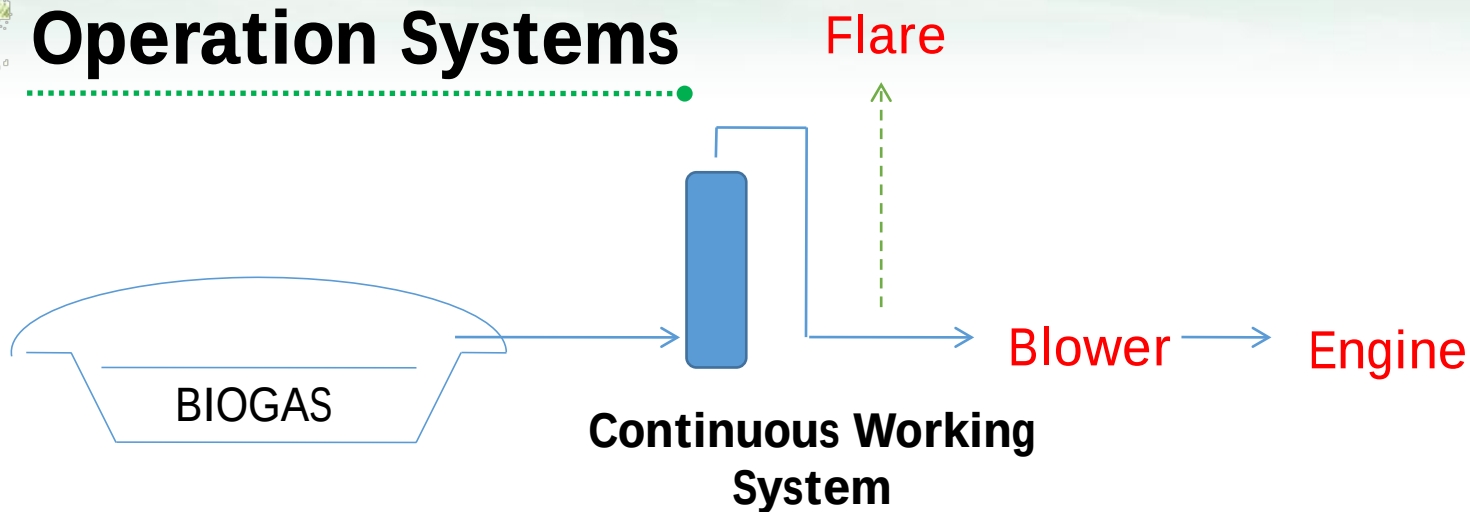




H₂S Bio-Scrubber System



Operation Systems





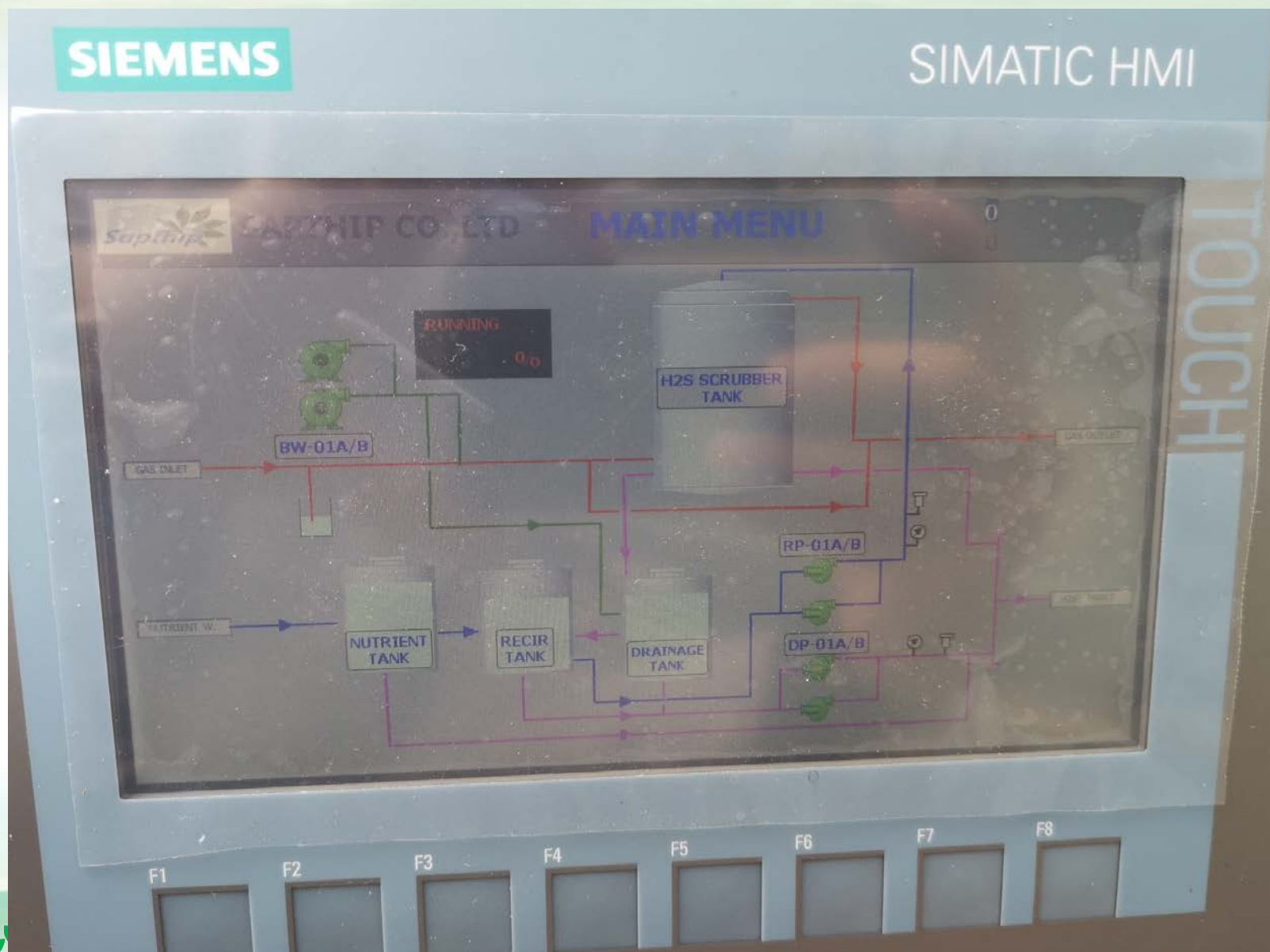
System Components





System Components





Project References



Thasae Landsettlement Cooperatives, Chumphon Province

 Type of Factory:	Palm Oil Mill
 Biogas Flow rate:	1,100 Nm³/hr
 H₂S Inlet:	2,000 - 3,000 ppm
 H₂S Outlet:	< 100 ppm
 Biogas Utilization:	Gas Engine Generator 2 MW



Project References



Prachongkit Palm Oil Co.,Ltd.

Ranong Province

 Type of Factory:	Palm Oil Mill
 Biogas Flow:	500 Nm³/hr
 H₂S Inlet:	2,000 - 3,000 ppm
 H₂S Outlet:	< 100 ppm
 Biogas Utilization:	Gas Engine Generator 1 MW



Project References



Ampol Food Processing Co., Ltd. Nakhon Pathom Province

-  **Type of Factory:** **Food Processing Factory**
-  **Biogas Flow:** **150 Nm³/hr**
-  **H₂S Inlet:** **3,000 ppm**
-  **H₂S Outlet:** **< 100 ppm**
-  **Biogas Utilization:** **Gas Engine Generator 600 kW**



Project References



Tepkincho Food Co., Ltd.

Samut Sakhon Province

💡 Type of Factory:	Food Processing Factory
💡 Biogas Flow:	50 Nm ³ /hr
💡 H ₂ S Inlet:	2,000 - 3,000 ppm
💡 H ₂ S Outlet:	< 100 ppm
💡 Biogas Utilization:	Thermal process in Burner



Project References



Thai Agro Energy Co.,Ltd.

Supanburi Province

💡 Type of Factory:	Ethanol Factory
💡 Biogas Flow:	1,800 Nm ³ /hr
💡 H ₂ S Inlet :	10,000 - 20,000 ppm
💡 H ₂ S Outlet:	< 200 ppm
💡 Biogas Utilization:	Gas Engine Generator 3.6 MW



Project References



EES Renewable Co., Ltd.

Ubon Ratchathani Province

💡 Type of Factory:	Tapioca Factory
💡 Biogas Flow rate:	2,000 Nm ³ /hr
💡 H ₂ S Inlet:	3,000 ppm
💡 H ₂ S Outlet:	< 100 ppm
💡 Biogas Utilization:	Gas Engine Generator 4 MW



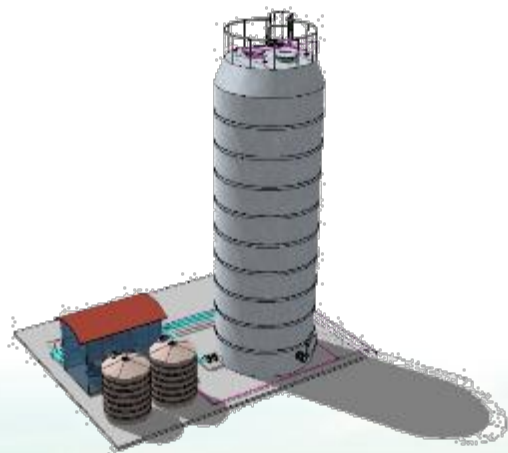
Project References



Somdej Starch Co., Ltd.

Kalasin Province

- 💡 **Type of Factory:** Tapioca Factory
- 💡 **Biogas Flow rate:** 1,700 Nm³/hr
- 💡 **H₂S Inlet:** 3,000 ppm
- 💡 **H₂S Outlet:** < 100 ppm
- 💡 **Biogas Utilization:** Gas Engine Generator 1 MW and Thermal Process in Burner



Project References



Napier Grass Biogas Power Plant, Prachuap Khiri Khan Province

- 💡 **Type of Factory:** Napier Grass Biogas Power Plant
- 💡 **Biogas Flow rate:** 350 Nm³/hr
- 💡 **H₂S Inlet:** 3,000 ppm
- 💡 **H₂S Outlet:** < 100 ppm
- 💡 **Biogas Utilization:** Gas Engine Generator 500 kW



Project References



Red Bull (1988) Beverage Co., Ltd. Kamphaeng Phet Province

- 💡 **Type of Factory:** Beverage Factory
- 💡 **Biogas Flow rate:** 250 Nm³/hr
- 💡 **H₂S Inlet:** 3,000 ppm
- 💡 **H₂S Outlet:** < 100 ppm
- 💡 **Biogas Utilization:** Thermal process in Boiler





City Courthouse

Ratchadaphisek Road
Ratchayothin
Lat Phrao

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OIC Bangkok



Food Court

Krungthai Bank



Tesco Lotus Express



Soi Rom Rat

Yak 1-1



Sooner - The Classical
Music School

Soi Ratchadaphisek 32

Soi Ratchadaphisek 32

Soi Ratchadaphisek 36



Food Court

By DITP



Food Court

Ratchada 32
Mini Plaza



Cafe Amazon

Department of International Trade
Promotion, Ministry of Commerce

Soi Ratchadaphisek 30

MRT Lat Phrao



Ratchada-Lat Phrao Intersection

Lat Phrao Road



MRT Lat Phrao