



Gasification for hydrogen production in China: Company activity

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I. Company profile



“A net-zero
emission target”

Renewable hydrogen
Is less than 1%

The industrial development of hydrogen by gasification is in China.
In total, **less than 10** plants of biomass gasification for hydrogen are running in China. Several plants are in preparation.

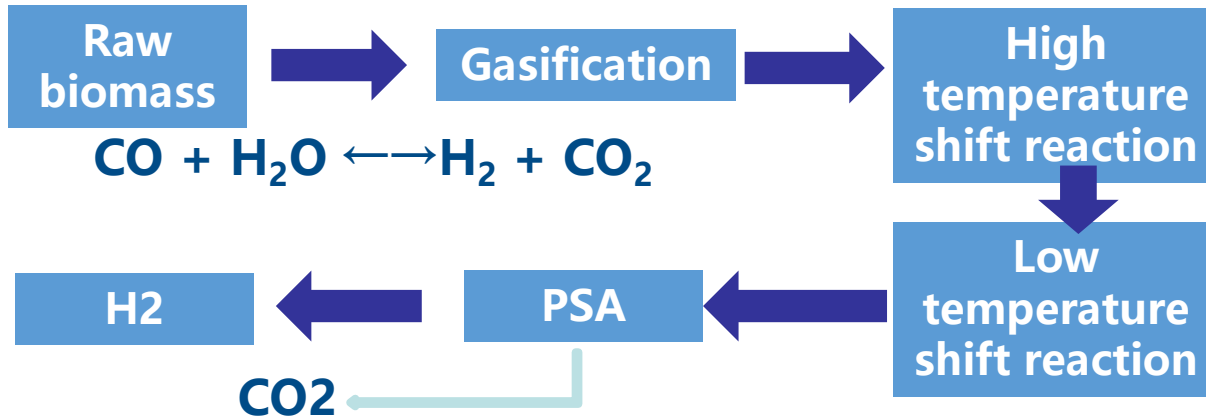
No.	Location	Company	Demo-projects
Case 1 	Ma ' Anshan, Anhui Province	China Datang Corporation Science and Technology General Research Institute Co. Ltd.	Biomass gasification- chemical looping hydrogen generation
Case 2 	Wuhan, Hubei Province	WUHUAN Engineering Co., Ltd.	Biomass high-temperature gasification for hydrogen production technology
Case 3 	Hefei, Anhui Province	Debo Energy Co., Ltd.	12MW Circulating Fluidized Bed for gasification coupled power generation

II. Gasification for hydrogen production- *Datang Co. Ltd*

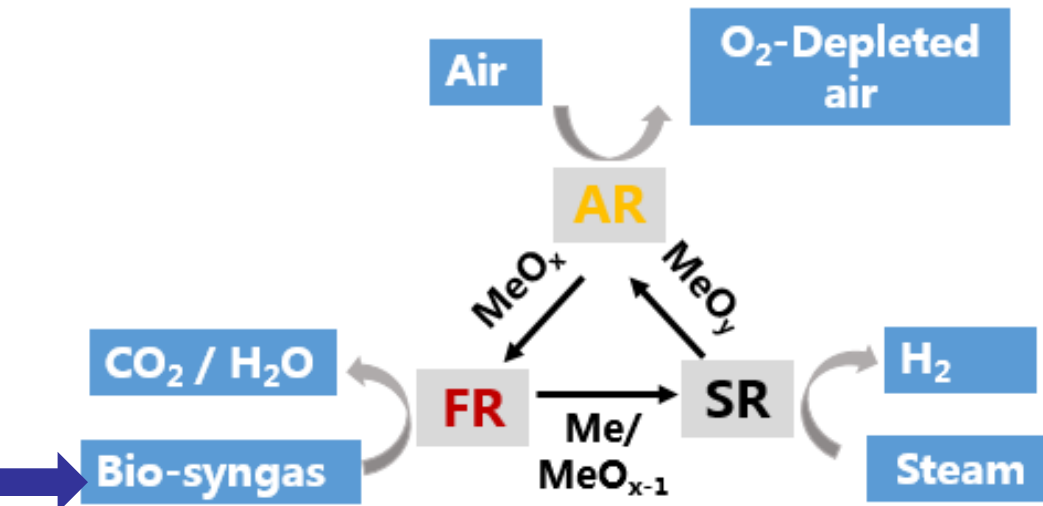
Case1: Biomass gasification-chemical looping hydrogen generation



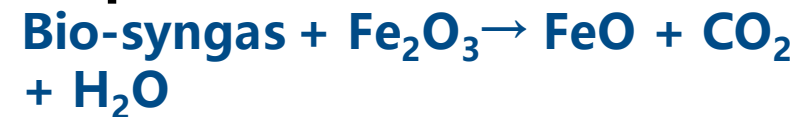
Conventional Biomass gasification for hydrogen generation



Biomass gasification-chemical looping hydrogen generation (Bio-CLHG)



Step1 (fuel reactor):



Step2 (steam reactor):



Step3 (air reactor):



II. Gasification for hydrogen production- *Datang Co. Ltd*

Bio-CLHG system (**Pilot scale-Demo scale, 2022.8**)

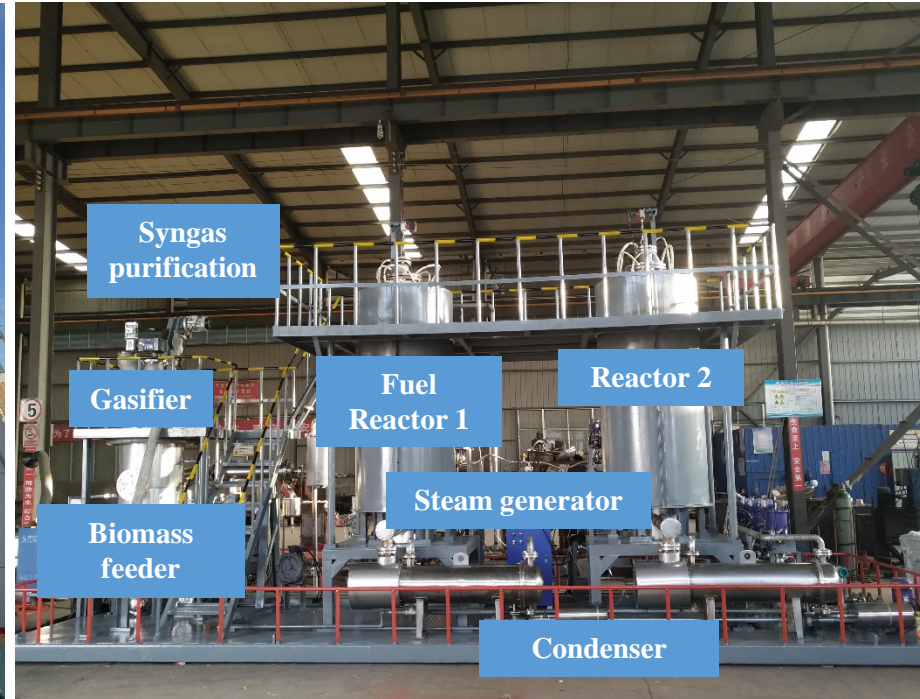
Location: Dangtu, Ma' Anshan in China

Feedstock: **Biomass pellet**

Biomass treating: **15 kg/h**

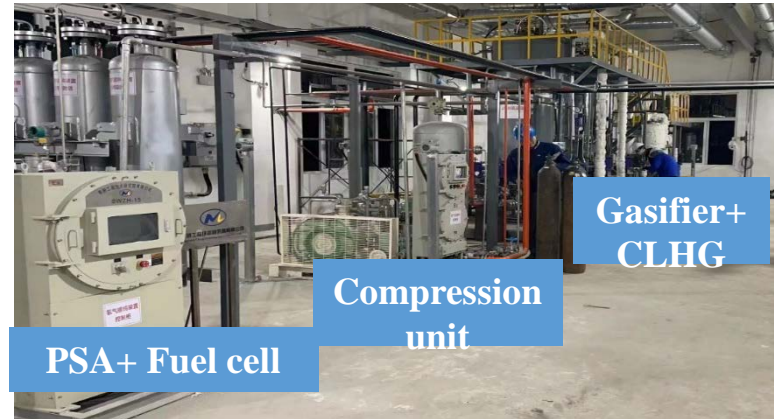
Products: **Hydrogen-Heat-Electricity**

Energy efficiency: **>57%**



II. Gasification for hydrogen production- *Datang Co. Ltd*

Bio-CLHG system (monitoring panel or screen) :
1 downdraft gasifier, 2 packed bed reactors, 1 compression unit, 1 PSA+PEM fuel cell



II. Gasification for hydrogen production- *Datang Co. Ltd*

◆ Biomass gasification(**down draft gasifier**)



Syngas composition:

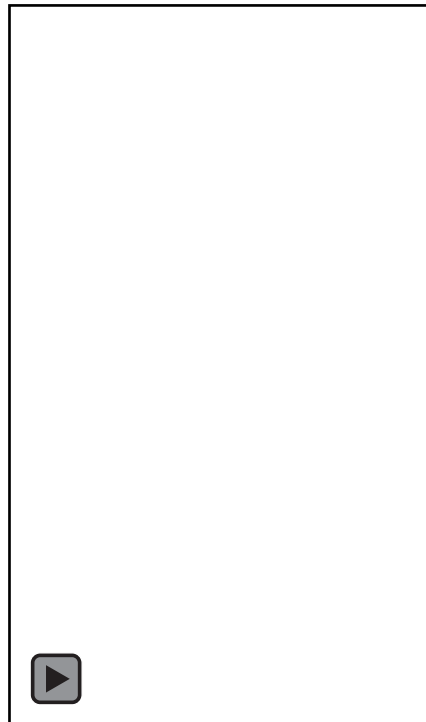
CO: 15~30%, H₂: 10~18%, CH₄: 1~4%, CO₂: 5~14, N₂: 45~60%

Gas yield: ~2 Nm³/kg

Heating Value: 4.5~6 MJ/Nm³

Gasification efficiency: 74~78%

H₂
12.63%

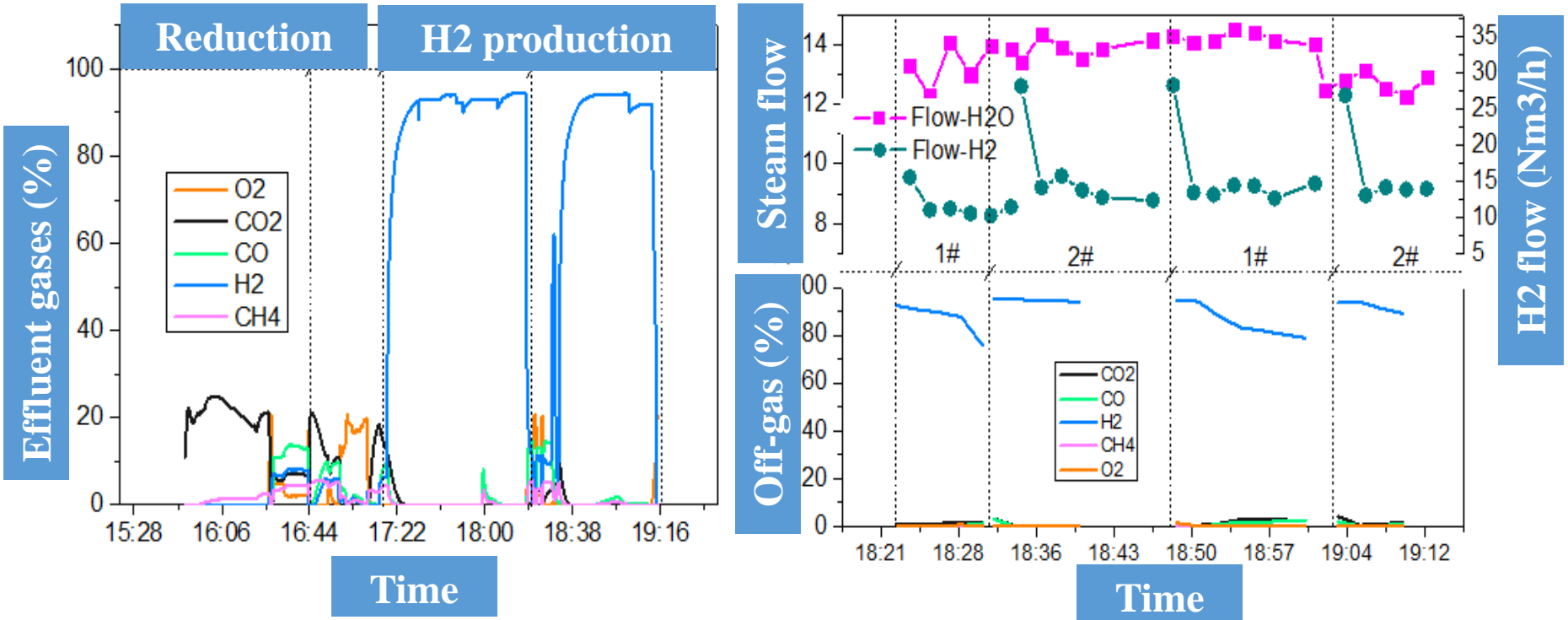


II. Gasification for hydrogen production- *Datang Co. Ltd*



◆ Bio-CLHG

- High purity of CO₂ was obtained in the reduction stage.
- H₂ purity via the Bio-CLHG reaches 90%-95%, others are uncondensed gas, and little residual syngas.
- Stable H₂ production: 10 Nm³/h.



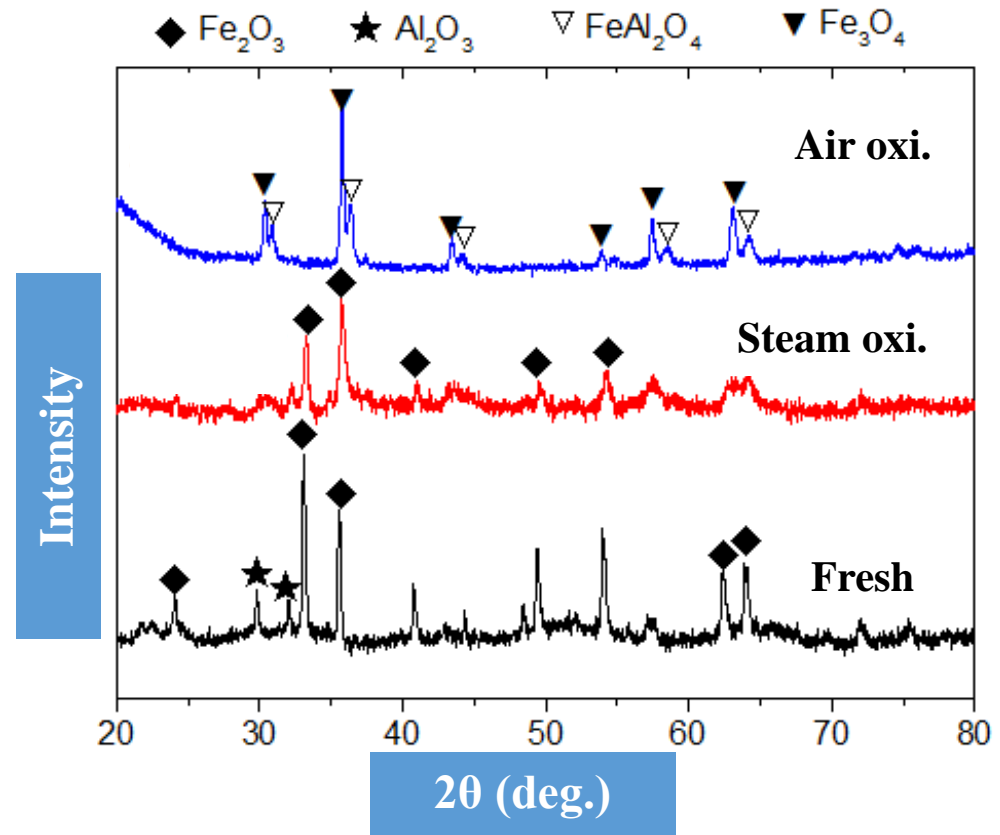
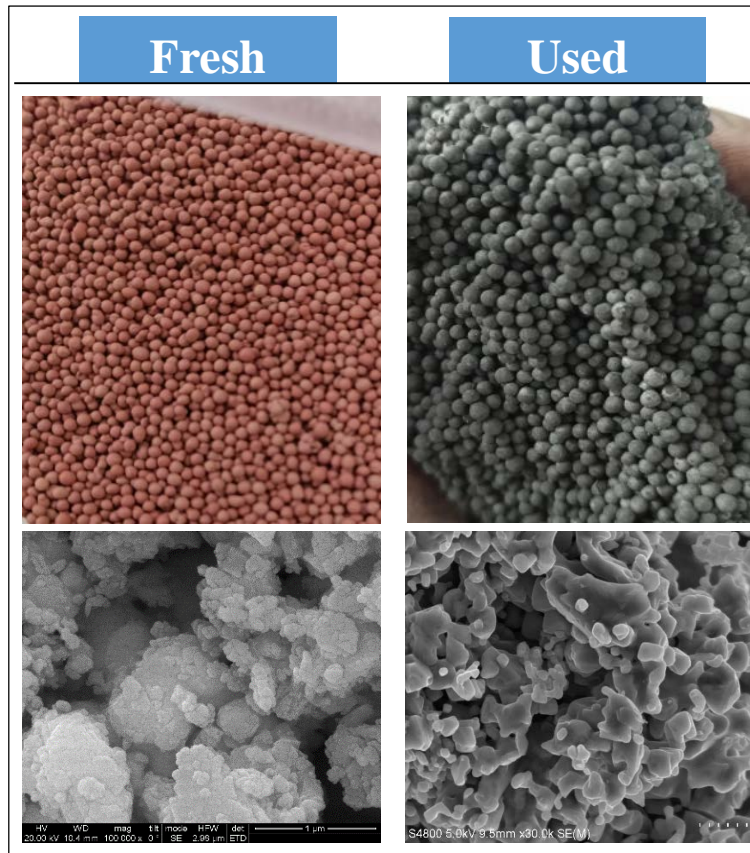
II. Gasification for hydrogen production- *Datang Co. Ltd*

◆ Oxygen carrier

Fe-Al composite oxide (Fe_2O_3 75 wt.%), mechanically mixing
+ disk pelletization

particle size: 1-2 mm

Chemically and mechanically stable



III. Projects or plants information- *Datang Co. Ltd*

Hydrogen production via gasification plants information

No.	Location	Company	Description
1	Ma' Anshan, Anhui Province (2022, commissioned)	China Datang Corporation Science and Technology General Research Institute Co. Ltd.	<ul style="list-style-type: none">• Biomass pellet gasification coupled with chemical looping hydrogen generation, and power generation (10 kW).• Downdraft gasifier with the feedstock of 15 kg/h.

IV Perspectives:

- **High efficiency Biomass gasification with Low tar yield.**
- **Large scale production of oxygen carrier with high reactivity and stability.**
- **Flexible, automatic and easy-control gasification & H2 production system.**



Gasification for hydrogen production in China: Company activity

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China Datang Co. Ltd.

WUHUAN Engineering Co., Ltd.

Hefei Debo Bioenergy & Technology Co., Ltd

I. Company profile- *WUHUAN Co. Ltd*

CNCEC China National Chemical Engineering Co., Ltd.

-  A share holding company, founded in 1953
-  One of the 225 global biggest entrepreneurs listed in ENR (American Engineering News Record) since 1995
-  The 12th among 60 strongest contractors assessed by China Architecture Times
-  Specializing in providing comprehensive engineering services throughout the whole project life, like EPC, PMC, BLT, BOT, BOOT etc.
-  Engineering achievements in chemical, oil refining, power plants, energy, environment, civil construction, municipal, water treatment, pharmaceutical, textile and other fields in more than 40 countries
-  Securities Code: 601117



I. Company profile- *WUHUAN Co. Ltd*

CWCEC / WUHUAN WUHUAN Engineering Co., Ltd.

-  A wholly-owned subsidiary of CNCEC, founded in 1958
-  Formerly the 4th Design Institute of China Ministry of Chemical Industry
-  One of the first engineering companies to be given **Class AAA credit rating** and **Class A comprehensive qualification certificates**
-  One of the most powerful engineering companies in the fields of coal chemical industry, ammonia and ammonia processing, phosphorus chemical industry, petrochemical industry, natural gas chemical industry, oil and gas storage and transportation, new materials, industrial environmental protection, etc..



II. Gasification for hydrogen production- *WUHUAN Co. Ltd*

Case: Biomass high-temperature gasification for hydrogen production technology

2.1 Technical definition, cores, positioning and characteristics



Definition and Cores

- Anaerobic pyrolysis of raw waste
- HT Gasification treatment of organic matter
- HT Melting treatment of inorganic matter



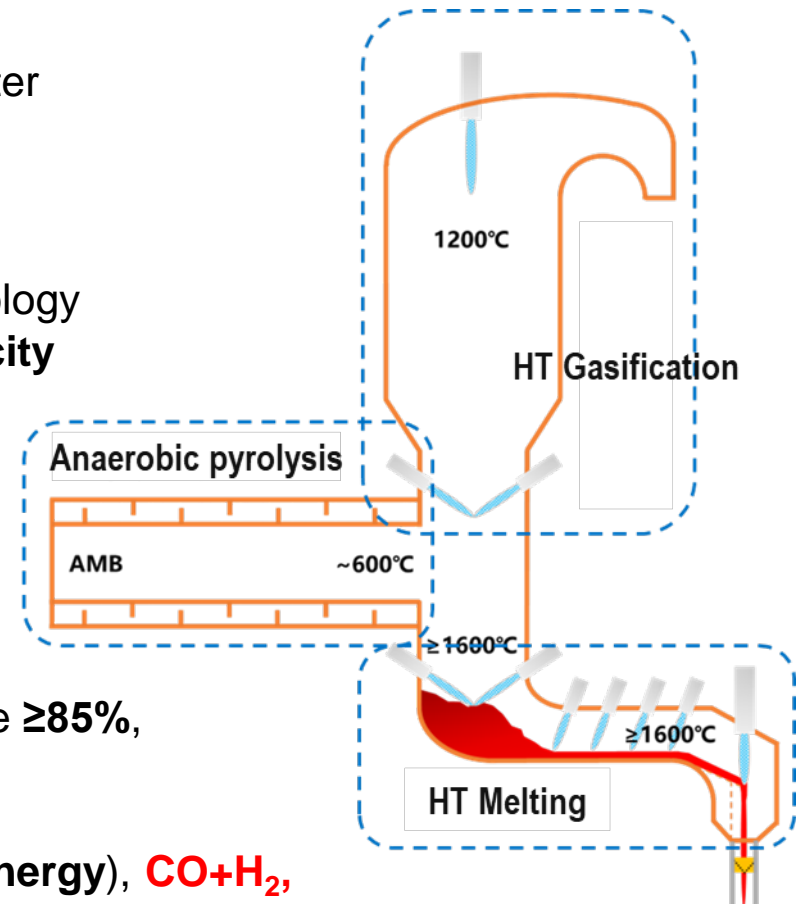
Positioning

- The ultimate solid waste treatment technology
- Conforms to the concepts of **waste-free city** and **zero landfill**
- Supplement and upgrade of incineration technology



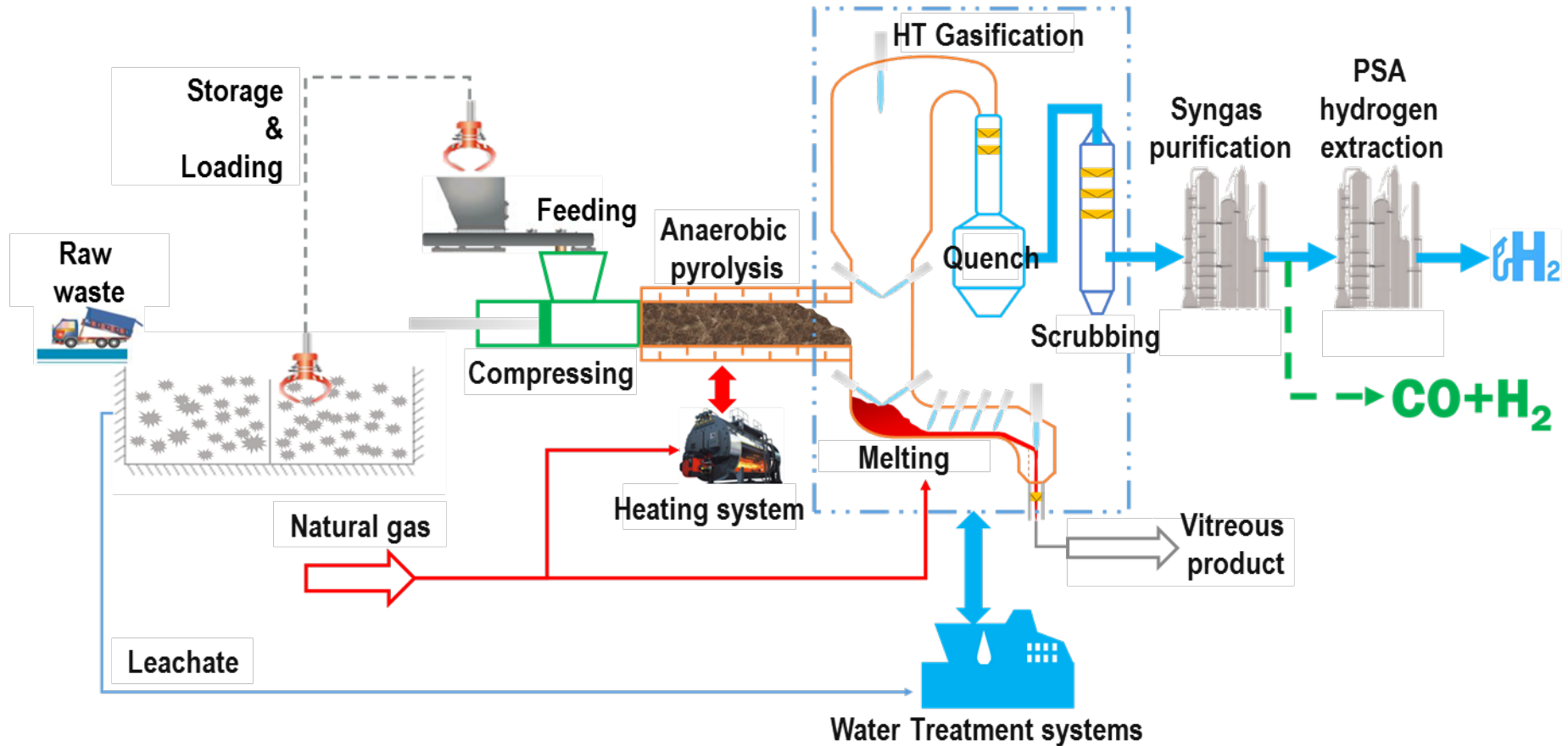
Characteristics

- Outstanding environmental advantages
- Harmlessness rate = **100%**, reduction rate $\geq 85\%$, resource utilization rate $\geq 95\%$
- Wide adaptability of raw waste
- Diversity of product solutions (**waste to energy**), **CO+H₂**, **H₂**, **methanol**, CNG/LNG or electricity etc.



II. Gasification for hydrogen production- *WUHUAN Co. Ltd*


2.2 Typical process flow diagram




II. Gasification for hydrogen production- *WUHUAN Co. Ltd*

2.3 Demonstration project example

 **Project:** High-temperature gasification for hydrogen production demonstration plant

 **Location:** Fangshan District, Beijing, China

 **Capacity:** 2 tons/day

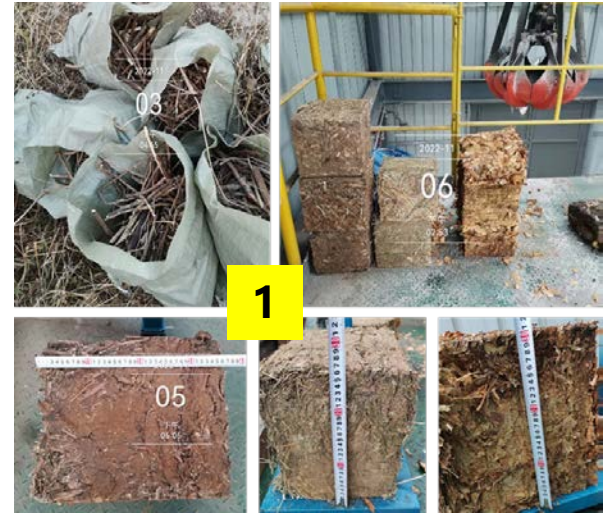
 **Floor space:**
2000m² for gasification plant,
15000m² for the whole project



II. Gasification for hydrogen production- *WUHUAN Co. Ltd*

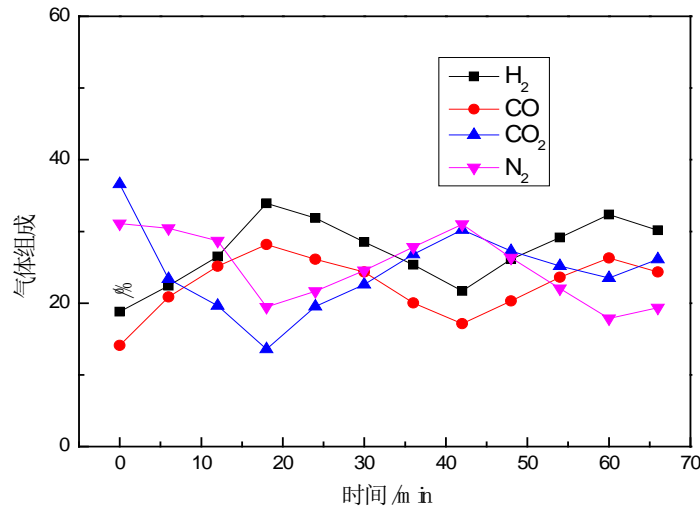
■ Raw waste types

1. Biomass: twigs, grass stems, leaves, etc.
2. Stale MSW
3. Classified MSW, RDF
4. Undisposed MSW
5. Municipal dried sludge
6. Industrial oil sludge



II. Gasification for hydrogen production- *WUHUAN Co. Ltd*

■ Syngas and Vitreous product



- ✓ The effective syngas concentration can reach 65%
- ✓ The hydrogen purity can reach 99.9%

急冷罐出口烟气的组分	
CO	29.62 %mol
CO2	17.57 %mol
N2	36.65 %mol
CH4	1.07 %mol
N2+O2	12.94 %mol
O2	0.00 %mol

急冷罐出口烟气的组分	
CO	28.63 %mol
CO2	17.90 %mol
N2	28.40 %mol
CH4	0.17 %mol
N2+O2	23.17 %mol
O2	0.00 %mol

急冷罐出口烟气的组分	
CO	26.50 %mol
CO2	24.24 %mol
N2	23.21 %mol
CH4	0.57 %mol
N2+O2	23.93 %mol
O2	0.00 %mol

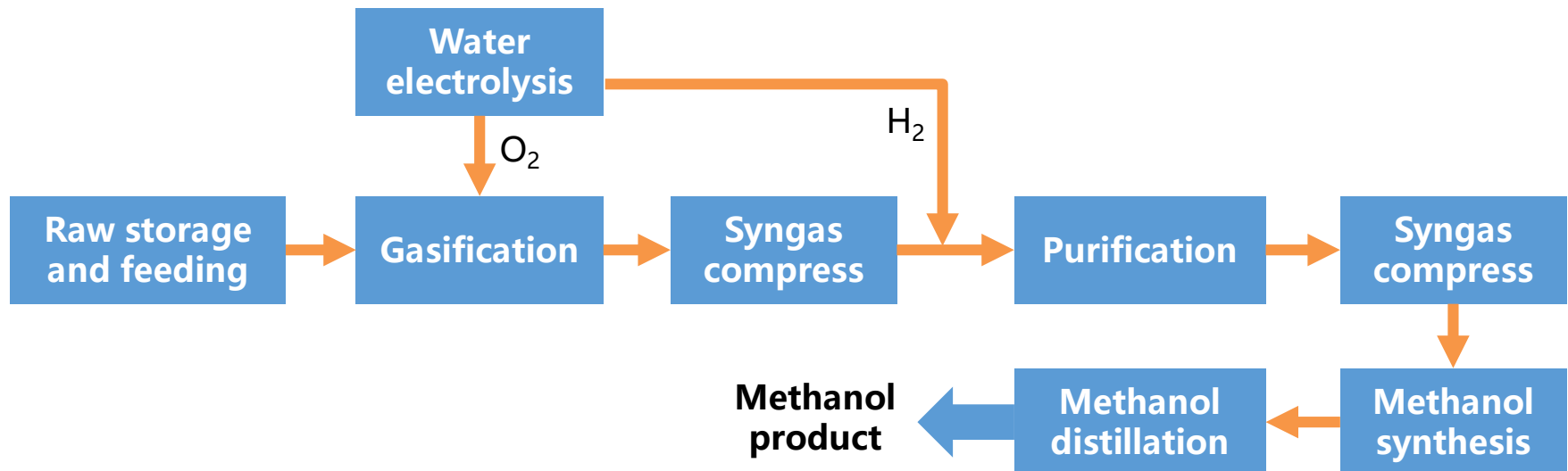
- ✓ The environmental protection characteristics of vitreous products are far better than the requirements of relevant standards (GB/T 41015-2021)



III. Projects or plants information- *WUHUAN Co. Ltd*

No.	Location	Contractor	Description
1	Jilin province (2022-now, Preparation)	CWCEC	<ul style="list-style-type: none">• Biomass gasification for methanol• High-temperature gasification technology of CWCEC• Two lines, 400 tons/day each line• Equipped with water electrolysis unit
2	Shanghai (2022-now, Preparation)	CWCEC	<ul style="list-style-type: none">• Biomass gasification for methanol• Atmospheric pressure circulating fluidized bed gasifier• Three lines• Raw material consumption: 45 tons/hour each line

■ Reference - process flow for Jilin project



IV. Perspectives- *WUHUAN Co. Ltd*

In the field of biomass gasification for hydrogen or methanol production, we suggest that the following points may be pay high attention:

1

A stable source of raw biomass

2

The comprehensive cost of hydrogen production

3

Stable hydrogen application scenarios

4

Industrial coupling with existing new energy (wind, solar, electricity) to produce hydrogen

5

Comprehensive environmental friendliness of technology



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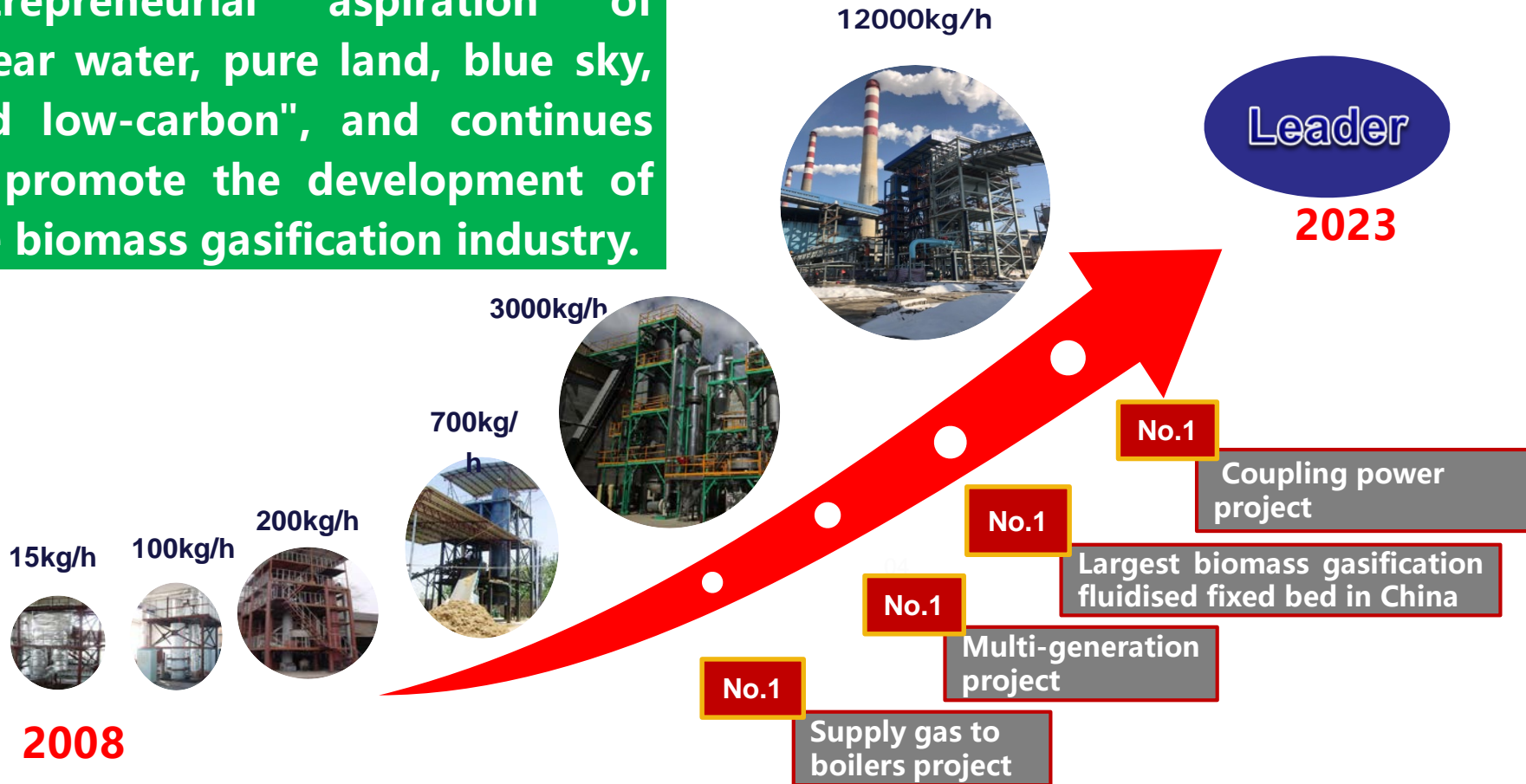
China Datang Co. Ltd.

WUHUAN Engineering Co., Ltd.

Hefei Debo Bioenergy & Technology Co., Ltd

I. Company profile- *Debo Co. Ltd*

Since its establishment in 2008, Debo adhered to the entrepreneurial aspiration of "clear water, pure land, blue sky, and low-carbon", and continues to promote the development of the biomass gasification industry.



Fifteen years and counting!!

I. Company profile- *Debo Co. Ltd*

Overview

Structure

Hefei Debo
Bioenergy &
Technology Co., Ltd

Anhui Debo
Yongfeng
New Energy
Company

Guodian Changyuan
Hubei Biomass
Gasification
Technology Company

Anhui Debo
Ecological
Environment
Company

Hefei Debo
Energy
Research
Institute

Debo
Biomass
Equipment
Company

Anhui Hongyuan
Biomass
Company

Jiangsu Debo
Rongbao Power
Co., Ltd

Zhongji Huaining

Hubei Debo

..... company

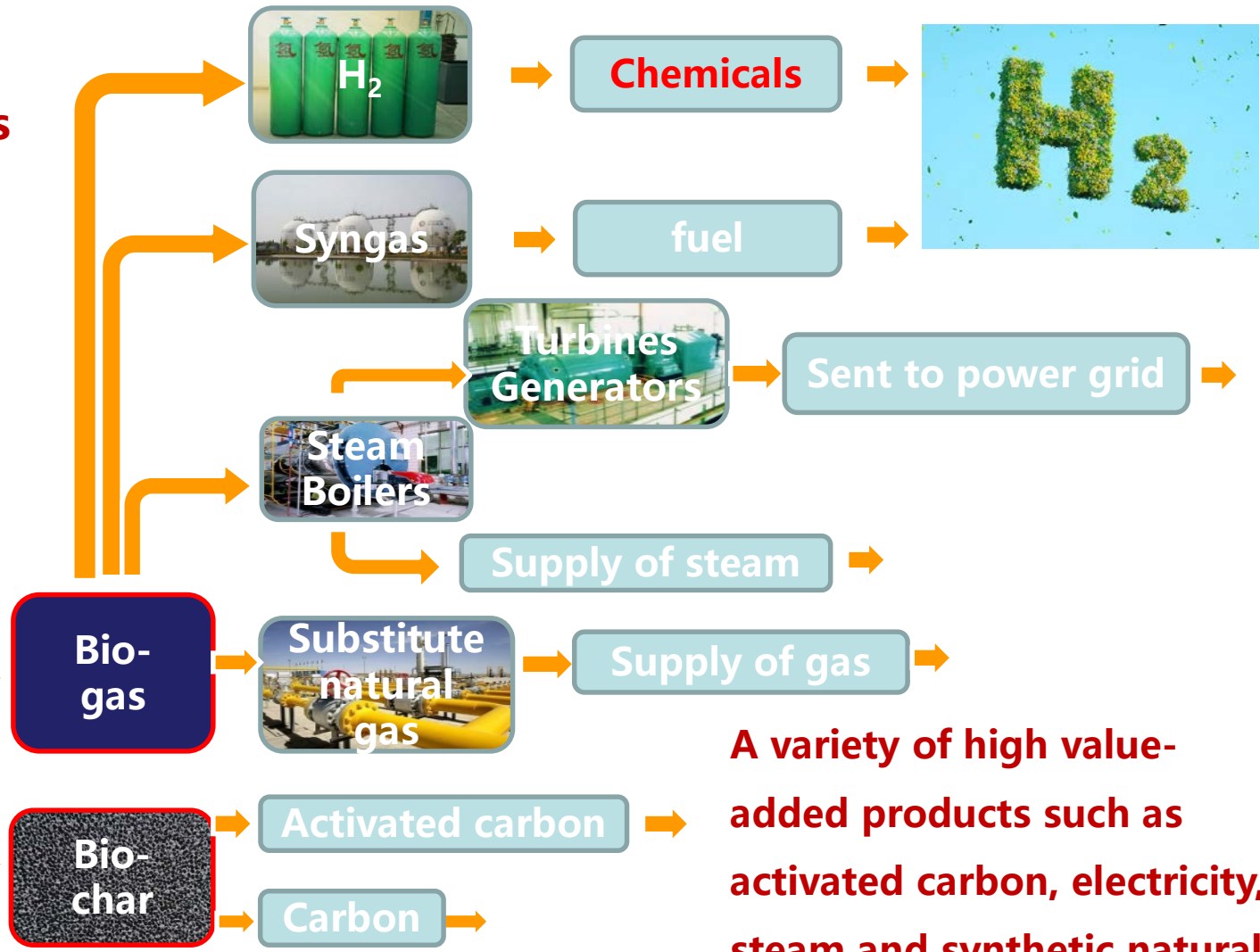
Jiangsu Debo
Yifeng Co., Ltd

Anguo Debo
Forward



II. Biomass gasification multi production - *Debo Co. Ltd*

Two basic products, biomass charcoal and gas, are obtained



A variety of high value-added products such as activated carbon, electricity, steam and synthetic natural gas are obtained.

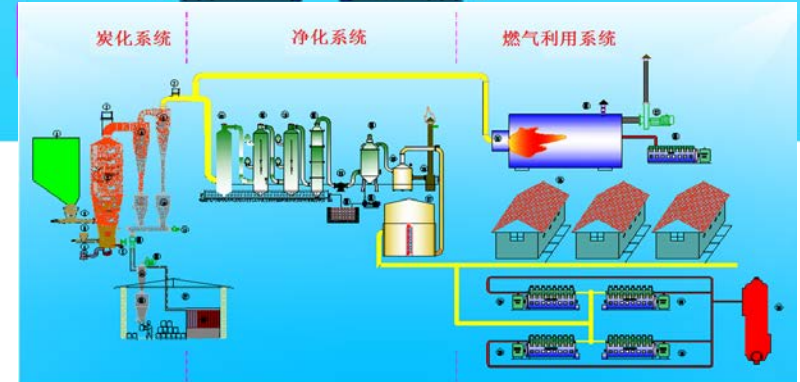
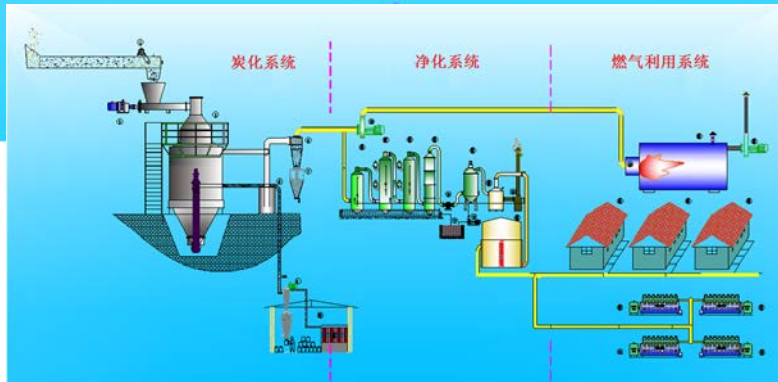
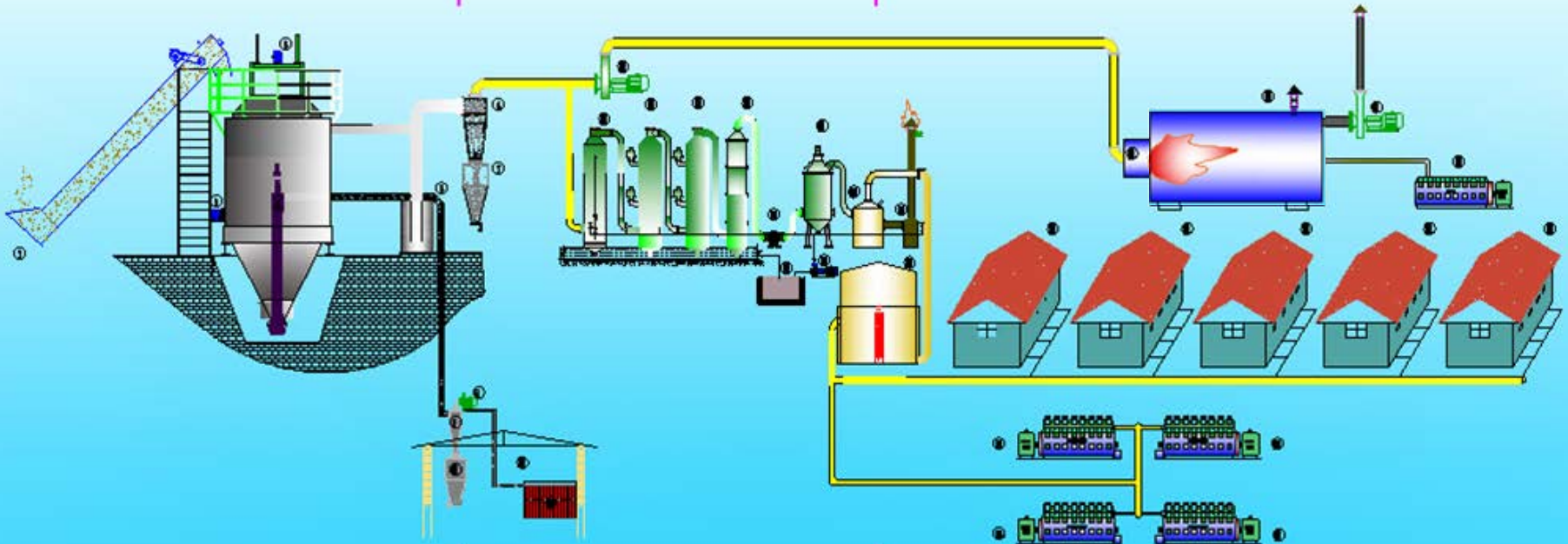
II. Biomass gasification multi production - *Debo Co. Ltd*

Gasification cogeneration system- Downdraft fixed bed Updraft fixed bed/ Fluidized bed

Carbonization system

Purification system

Gas utilization system



III. Projects or plants information- *Debo Co. Ltd*

- Guodian Jingmen Power Plant 10.8MW Biomass Gasification Coupled Coal-fired Unit Power Generation Project
- Huadian Xiangyang Power Plant 12MW Biomass Gasification Coupled with Coal-fired Unit Power Generation Project
- Hebei Pingquan 3MW Apricot Shell Gasification Power Generation Coupled with Activated Carbon, Heat and Fertilizer Project



- Yunnan Xishuangbanna 1MW Biomass Gasification Power Generation Co-production Activated Carbon Project
- Jiangxi Fengxin 5MW Biomass Gasification Power Generation Co-generation Project
- 1MW Biomass Gasification Power Generation Project in Myanmar



- Jilin Changchun 2×2500Nm³/h biomass gasification fired boiler co-production charcoal project
- Heilongjiang Qing'an 500KW gasification power generation heating and co-production charcoal project
- Zhejiang Jiande 400KW Biomass Gasification Power Generation Co-production Charcoal Project



- Jiangsu 2500Nm³/h biomass gasification fired boiler co-generation carbon project
- Shandong Weihai 6MW Biomass Gasification Turbine Power Generation Co-generation Charcoal Project
- Jiangxi Shanggao 2MW Biomass Gasification Power Generation Co-production Charcoal Project

- Datang Huayin 3MW Biomass Gasification Power Generation Co-generation Charcoal Project (under construction)
- Anhui Wangjiang 500kW Biomass Gasification Power Generation Co-production Charcoal Project
- Shanghai Electric 40kW Biomass Gasification Power Generation Project
- Hunan Xiangxi 1MW Oil Tea Shell Gasification Power Generation Co-production Charcoal Project (under construction)
- Jiangsu Xinghua Biomass Gasification for 4t Boiler Co-generation Charcoal Project

More than 100 successful cases in China and abroad

III. Projects or plants information- *Debo Co. Ltd*

Case 1: Biomass gasification coupled power generation



The project of state grid Hubei Wuhan's 10.8MW circulating fluidized bed gasification coupled power generation

III. Projects or plants information- *Debo Co. Ltd*

Case 2: Biomass gasification coupled power generation



The project of Huadian's 12MW Circulating Fluidized Bed for gasification coupled power generation in Xiangyang, Hubei

The first pilot in China to pass the NEA assessment

III. Projects or plants information- *Debo Co. Ltd*

Case 3: Biomass gasification multi-generation in Greece



The project of biomass gasification for electricity generation in Greece

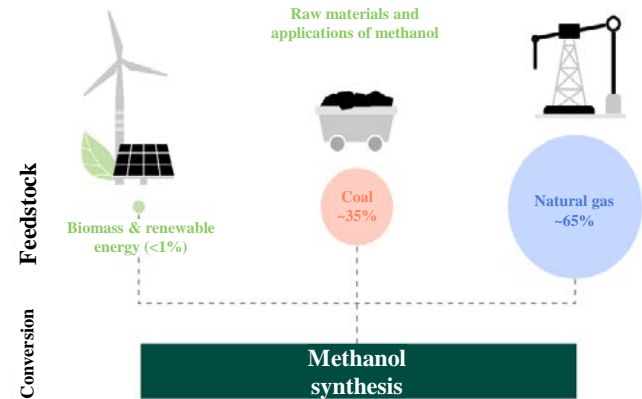
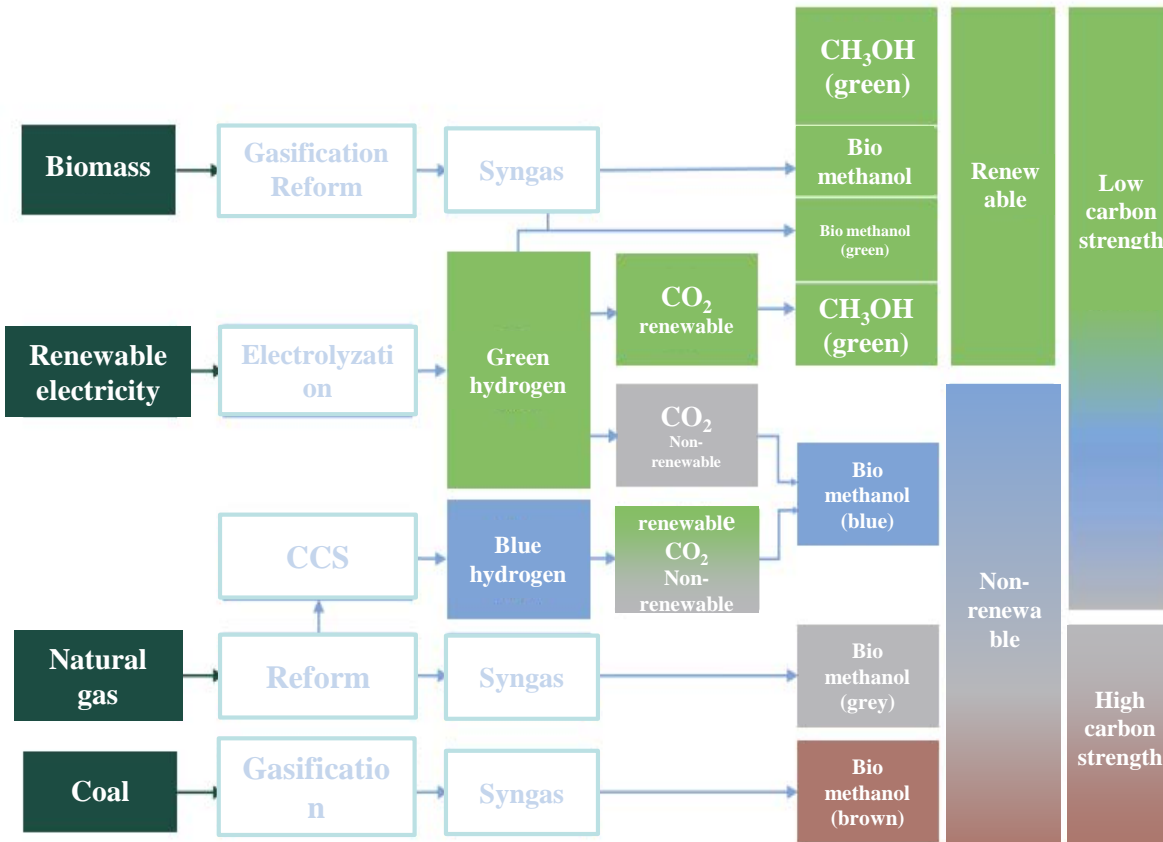
III. Projects or plants information- *Debo Co. Ltd*

Case 4: Biomass gasification multi-generation in Slovenia



The project of biomass gasification for electricity generation in Slovenia

IV. Perspectives- *Debo Co. Ltd*



➤ About 65% of the world's methanol comes from natural gas synthesis, 35% from Coal gasification synthesis, and the proportion of green methanol output is less than 1%. 88% of methanol in China comes from coal to methanol, and 12% comes from natural gas.

Development direction of biomass gasification:

Methanol production, aviation fuel production, hydrogen production

IV. Perspectives- *Debo Co. Ltd*

Commercial Progress of Debo in the Preparation of Synthetic Methanol from Biomass Gasification



Signing of intent agreement with Maersk

- According to Maersk's plan for 2030, the demand for green methanol will reach more than 1 million t per year.
- Maersk is currently looking for potential green methanol producers worldwide and is currently working with Debo on two 100,000 t per year green methanol projects.

Demand and Market of Green Methanol

