Efficient and Clean Utilization of Biomass Gasification Technology

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Introduction of BTCL, GIEC, CAS

- GIEC,CAS was founded in 1978
- Engaged in new and renewable energy R&D
- Staffs: 390
- Students:164 (Ph.D 55, Master 109)
- Located in Guangzhou, Guangdong Province

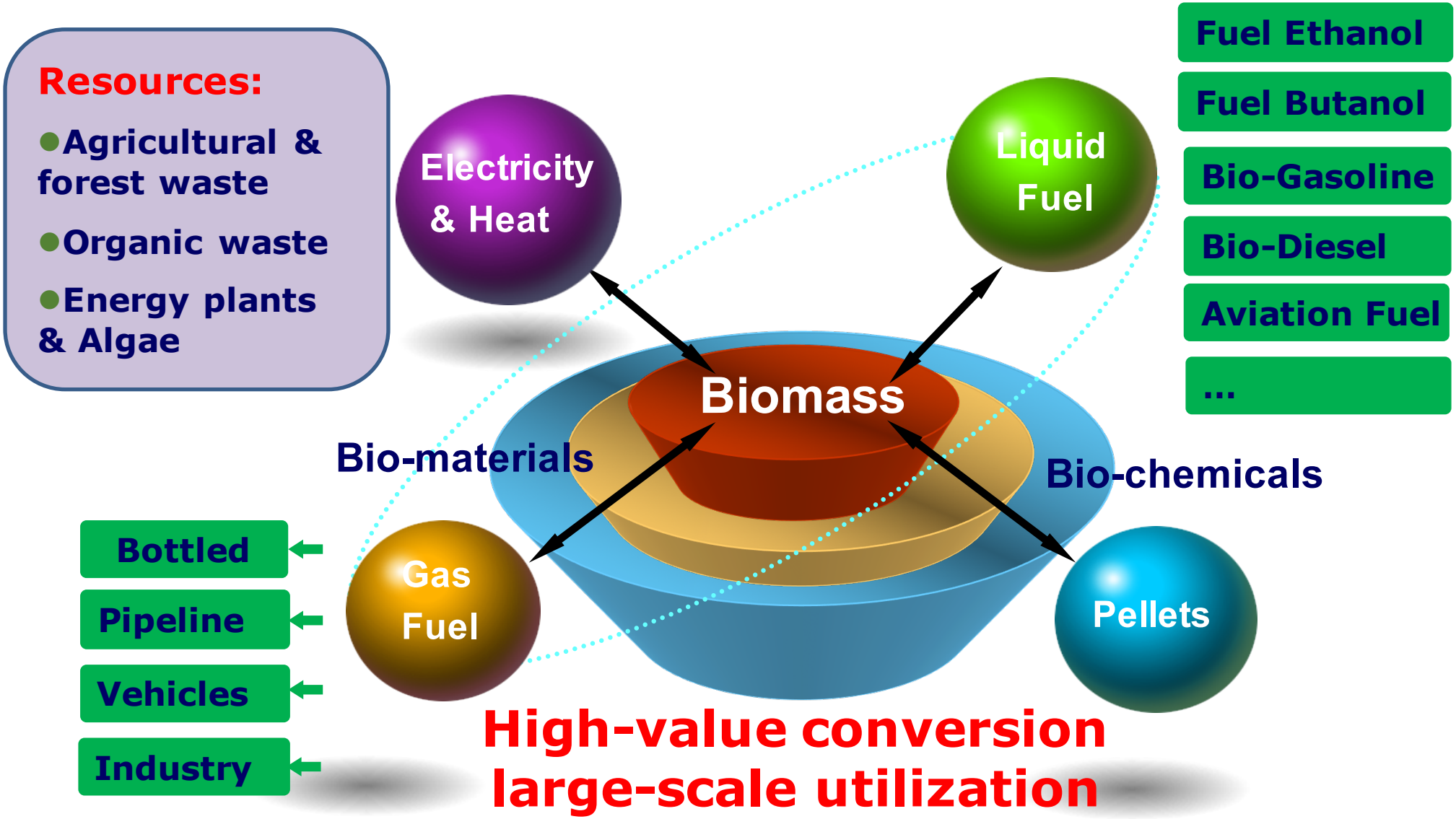
BTCL is one of the earliest research groups engaged in biomass energy in China.

BTCL specializes in gasification, pyrolysis and combustion processes for converting biomass to fuels, chemicals, heat and power.

Lab. Member: 30

- **15 staffs**
  - 2 Prof.
  - 5 Associate Prof.
  - 5 Senior Engineer
  - 3 Assistant Prof..
- **5 technicians**
- **10 students**

Biomass Energy



1. Background

Demand for clean energy and atmospheric environmental protection

Date of Issue	Policy & Planning	Purpose
August, 2012	The 12th Five-Year Plan for Energy Saving and Emission Reduction	**Control of coal consumption**
September, 2012	The 12th Five-Year Plan for Prevention and Control of Air Pollution in Key Regions	**Development of clean energy**
January, 2013	The 12th Five-Year Plan for Energy Development	
September, 2013	Action Plan for Air Pollution Control	**Prevention of air pollution.**
May, 2014	Program for Strengthening of Air Pollution Control in Energy Industry	

Demand for Clean Energy

- Coal consumption in 2017 is planned to be reduced to 65% or less;
- For natural gas, consumption is rising, but with high dependence on imports;
- Biomass (as clean fuel) is supported by government.

1.Background

To better prevent air pollution, policies have been issued more specifically.

Encouragement	Standardization & Guidance
In June 2014, Demonstration of BMF-based heat supply is encouraged by the Bureau of Energy and the Ministry of Environmental Protection.	In 2014, guidelines for pollution prevention during BMF utilization was issued by the Zhuhai government.
Before 2012, small and medium-scale coal boiler is restricted and BMF (biomass molding fuel) is subsidized in many cities.	Since 2013, direct burning of biomass fuel has been forbidden in the key regions of major cities.
Before 2009, BMF had not been related to high pollution fuel.	In 2011, provisional measures for BMF utilization was issued by Luogang District, Guangzhou.

"Delimitation plan for areas prohibited from high pollution fuel burning" was issued by the Beijing Government (2014) – Burning of "high pollution fuel (listed below)" will be completely prohibited in six districts of Beijing at the end of 2020.

✓Biomass fuel for direct burning (bark, straw, sawdust and bagasse etc.);

✓Biomass molding fuels **(fuel gas from gasification not included).**

1. Background

Biomass is the only one kind of renewable energy that can be stored, and that can be used directly as fuel.

Features of biomass

- Carbon neutral;
- Multiple species & High moisture content & Low heating value;
- Disperse distribution & Strong seasonal sensitiveness;
- Difficult to ensure large-scale and stable supply.

Distributed utilization is the trend of biomass energy development

- High efficient and clean utilization
- Moderate exploitation
- In line with local conditions
- Alternative fuels
- Multi energy complementary

1. Background

Recent social responsibility of biomass energy

— Haze Prevention

- ✓ Severe pollution: Massive hazardous gases and suspended particles.

1. Background

Social function of bioenergy in the long run
—New urbanization plan

Exploiting and utilizing bioenergy is of great strategic and practical meaning for the development of economy and new energy supply structure in rural areas.

Using straw to supply life energy, including power, heat and fuel gas, is an effective measure to overcome coal independence in rural areas and increase economic income of farmers.

2.Platform for bio-syngas utilization

Biomass Feedstock

- Trees
- Grasses
- Agricultural Crops
- Agricultural Residues
- Forest Residues
- Animal Wastes
- Municipal Solid Waste

Conversion Processes

- Enzymatic Fermentation
- Gas/liquid Fermentation
- Acid Hydrolysis/Fermentation
- Gasification
- Pyrolysis
- Combustion
- Co-firing

PRODUCTS

Fuels:
- Ethanol
- Renewable Diesel
- Renewable Gasoline
- Hydrogen

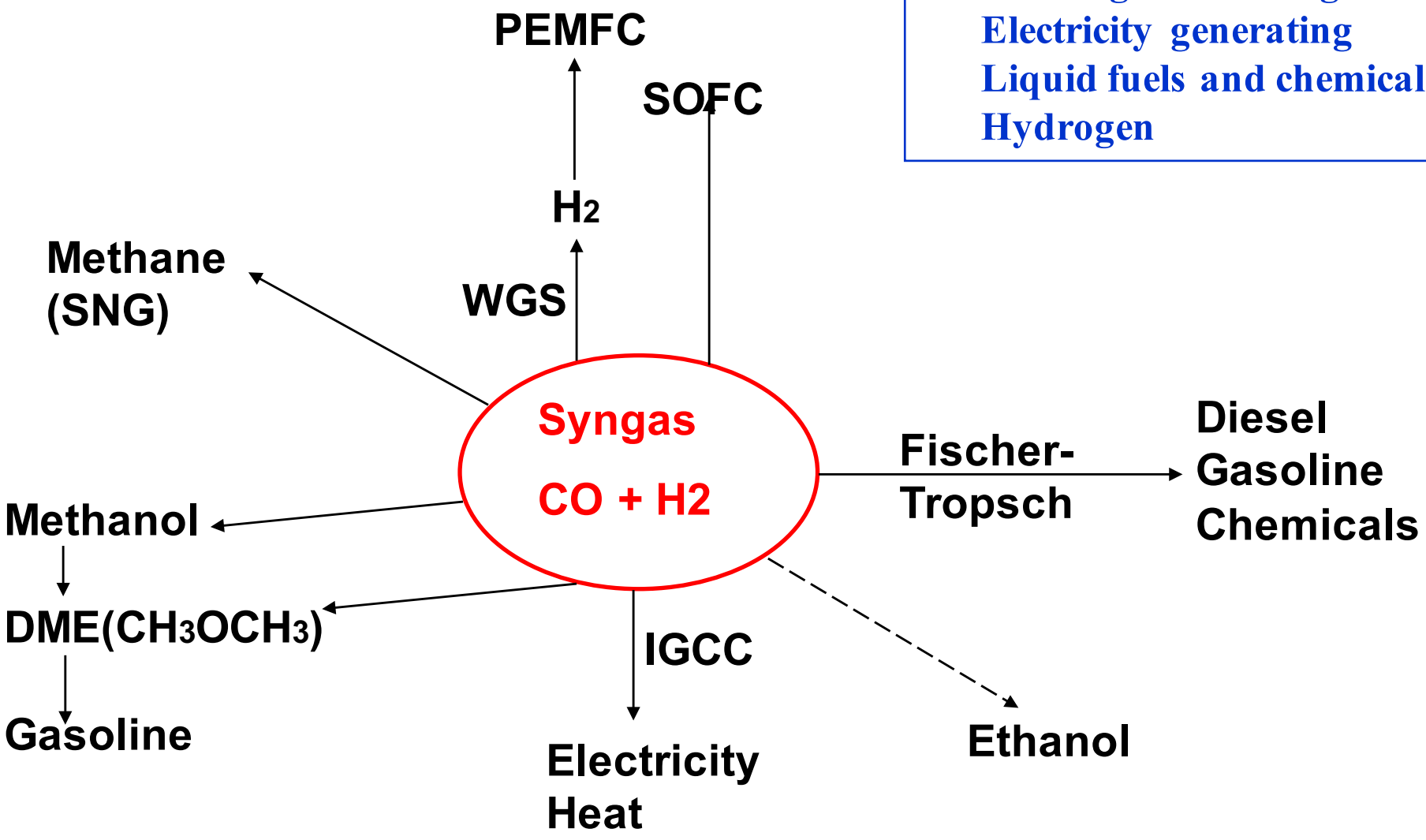
Power:
- Electricity
- Heat (co-generation)

Chemicals
- Plastics
- Solvents
- Chemical Intermediates
- Phenolics
- Adhesives
- Furfural
- Fatty acids
- Acetic Acid
- Carbon black
- Paints
- Dyes, Pigments, and Ink
- Detergents
- Etc.

Food, Feed and Fiber

2.Platform for bio-syngas utilization

Cooking and heating
Electricity generating
Liquid fuels and chemicals
Hydrogen



2.Platform for bio-syngas utilization

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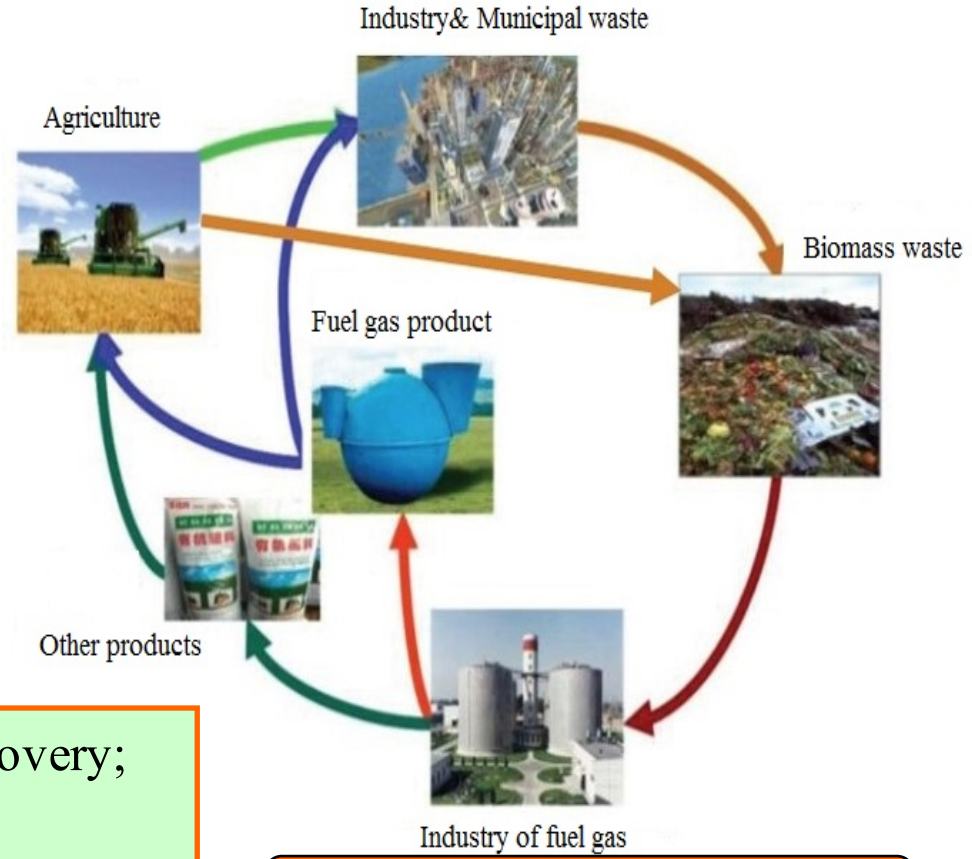


Fuel gas utilization

- High-efficiency conversion and energy recovery;
- Reduction of emissions of pollutants
- High-quality syngas and high value-added;
- **Reduce, Reuse** and **Recycle**.

Gasification is an efficient and advanced technology, its resulting gas mixture (syngas), may be used for drying and heating, domestic cooking, power generating, and fuel/chemicals synthesizing.

2. Platform for bio-syngas utilization

-- Status of technology

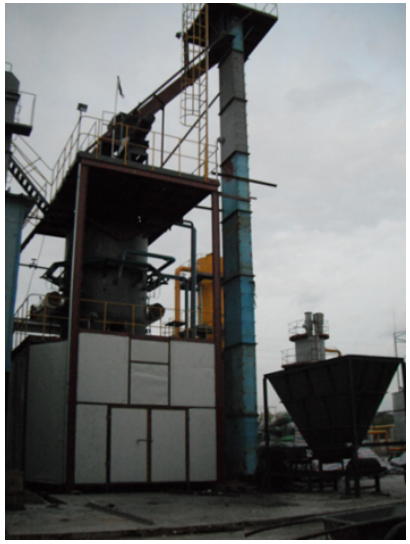
- **BTCL** has established demonstration projects of power generation, heat and gas supply, CHP, fuel/chemical synthesis based on biomass gasification, some of which have been put into commercial operation.
- A variety of feedstock have been tested and proved to be feasible, including woodchips, straw, palm kernel shell, RDF, de-inking sludge and industrial waste from production of paper, Chinese medicine, furniture etc.
- Technical advantages: Easy to start and stop; Stable operation; High fuel flexibility; Low tar content of syngas.

3.Key technology --briquette fuel, pellet fuel

3.Key technology -- gasifier

➔Novel gasifiers: Low tar content, Easy reform of gas composition; Strong load adaptability; Stable operation; Easy to be enlarged.

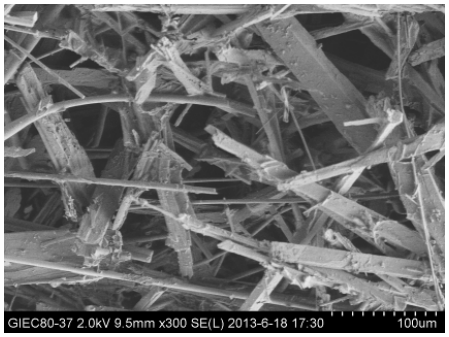
➔Fixed-bed gasifier (1.5 t/h) and fluidized-bed gasifier (5 t/h) with high fuel flexibility are available, which can be used to supply syngas for boiler, kiln, power generation system, fuel/chemical synthesis, and Fuel Cell.

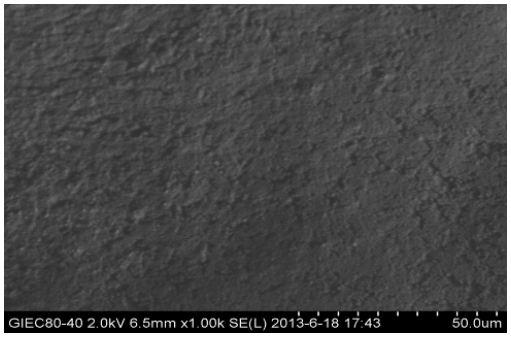


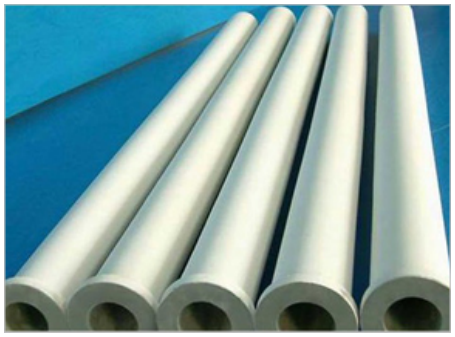
3.Key technology— Hot gas cleaning

➔An integrated process for high-temperature (400-500℃) dust and tar removal is developed, whose dust removal efficiency and tar removal efficiency reach up to 99% and over 95%, respectively.

➔The dust and tar content can be reduced to 10 mg/Nm^3 and 20 mg/Nm^3 respectively, which can meet the requirements of power generation and fuel synthesis.



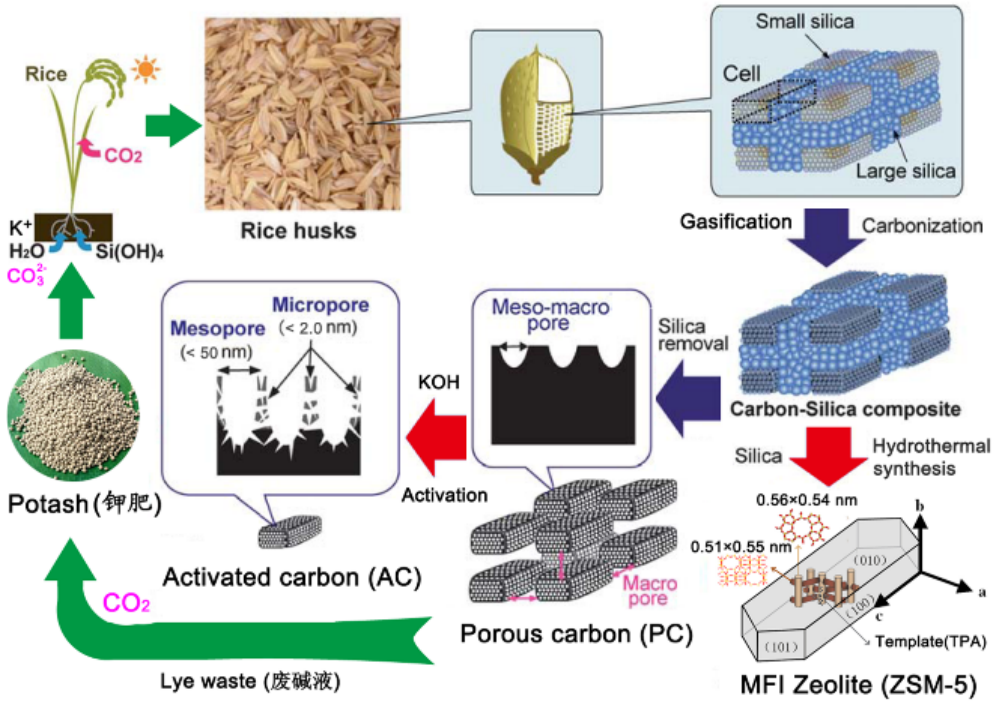




3. Key technology --high-value utilization of ash

A novel process for polygeneration of zeolite, active carbon and potash fertilizer from ash of biomass such as rice husk.

Poly-generation facility based on rice husk ash (1 kg/h)



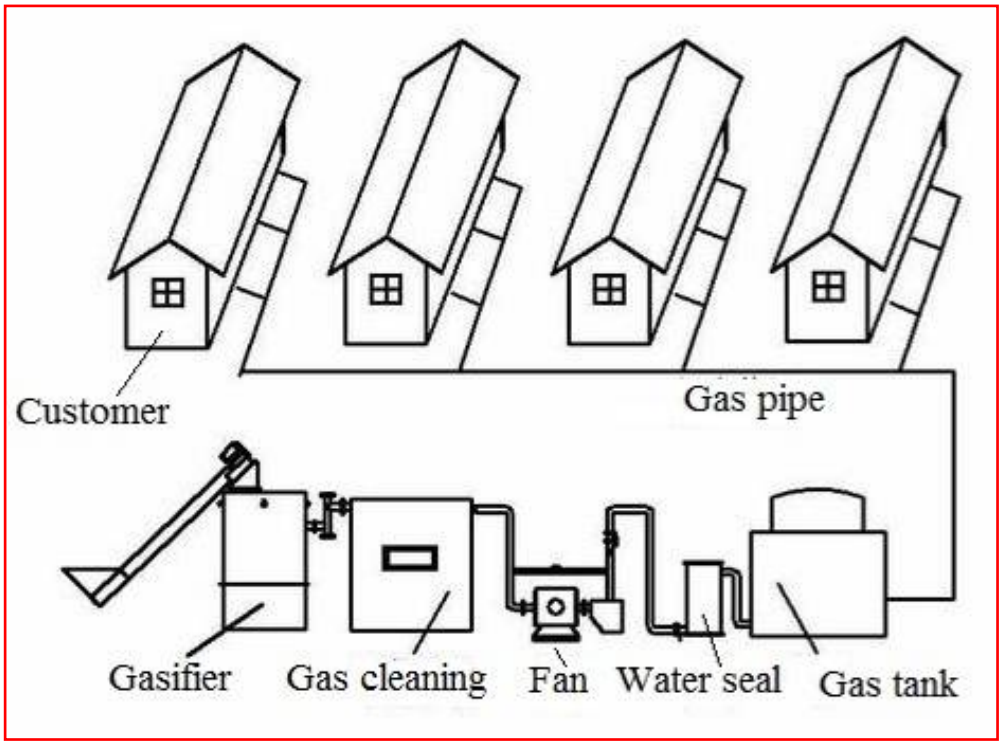
3.Key technology --Centralized fuel gas supply

- ✓ economically feasible for villages and industrial parks.

(a village or a few villages units, system size of tens to thousands household)

- ✓ For villages, fuel gas is served for livelihood as energy for cooking and space heating.

- ✓ For industrial parks, fuel gas is used as substitute or supplementary of natural gas.



4.Demonstration and Industrialization

--bio-syngas used as substitute of kiln/boiler fuel

- Bio-syngas can be directly used in coal or natural gas boiler;
- No dust removal device is needed to meet the emission standards of natural gas boilers;
- Suitable in cities or regions with high emission standards.
- The most promising way for energy conservation and reduction of emissions.

--successfully used for steel calcination, aluminum melting, copper melting, stainless steel annealing, ceramic kiln, etc.

--6 demonstrations, with a total biomass consumption of about 200,000 tons/year, which can substitute 60 million m^3 natural gas and reduce 200,000 tons of CO_2 emission.

Pharmaceutical factory
9400 t biomass/year

Aluminum melting
54000 t biomass/year

Copper melting
5000 t biomass/year

Food processing
10500 t biomass/year

Steel annealing
Substitute of 170,000 t fuel oil/year

4.Demonstration and Industrialization

--Biomass gasification power/heat/gas cogeneration system

- Use straw to supply energy (cooking and space heating) for livelihood in rural areas.
- Prevent air pollution from filed burning of straw and reform the energy structure of rural areas.

A demonstration project has been accomplished, with the following parameters: Capacity 2 MW; Electric efficiency of generator set >34%; Waste heat recovery efficiency 52%; Overall electric efficiency >26%; Overall thermal efficiency >52%.

1MW Biomass Gasification and Power Generation System

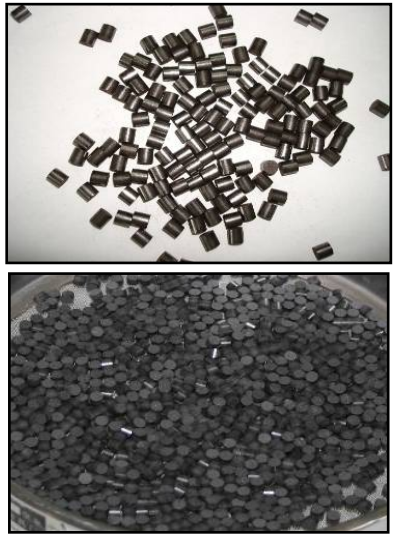
5.5MW Gasification and Power Generation System

$2MW_e$ CHP project, Foshan, launched in 2013

4.Demonstration and Industrialization

--Liquid fuels synthesis from biomass derived syngas

✓Demonstration of 1000 tons/year liquid fuels synthesis from biomass derived syngas has been established, which integrated biomass gasification, syngas cleaning and power and/or steam generation system. The overall systematic efficiency is higher than 40%.

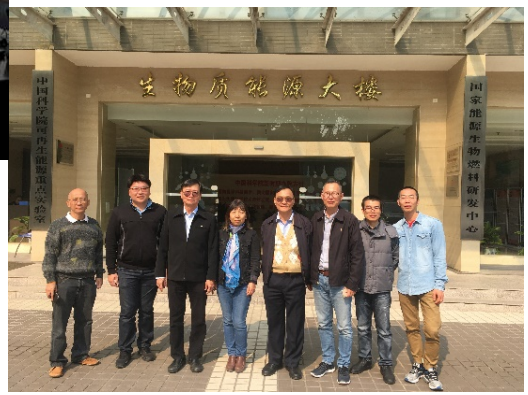


Bio-syngas production and gas cleaning

Liquid fuel synthesis

5. Suggestion

- Southeast Asia is important areas along the “Belt and Road” route.
- Myanmar is rich in biomass resources （Rice, cassava, corn, soybeans, sugar cane, etc.）and short of electricity supply, so it has the market prospect of developing biomass energy.
- The development of biomass energy can help to establish a sustainable energy supply system, protect the ecological environment and promote the development of rural economy.



Thank You

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