Introduction of Coal Gasification Technologies

Yang Lijian

CNCEC-China Tianchen Engineering Corporation

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1、Coal Chemical Industrial Chain

Coal

Coking

Coke

Calcium carbide

Ethyne

Coal tar oil

Benzene

Oven gas

Gasification

Syngas

Ammonia

Oxalic ester

Glycol

SNG

Methanol

Gasoline（MTG）

Dimethyl ether

Olefin（MTO/MTP）

Arene（MTA）

Acetic acid

Oxygenated chemicals

Liquefaction

Gasoline

Diesel

Aviation kerosene

F-T Synthesis

Naphtha

Diesel

LPG

Fine chemicals

Traditional coal chemical industry

Advanced coal chemical industry

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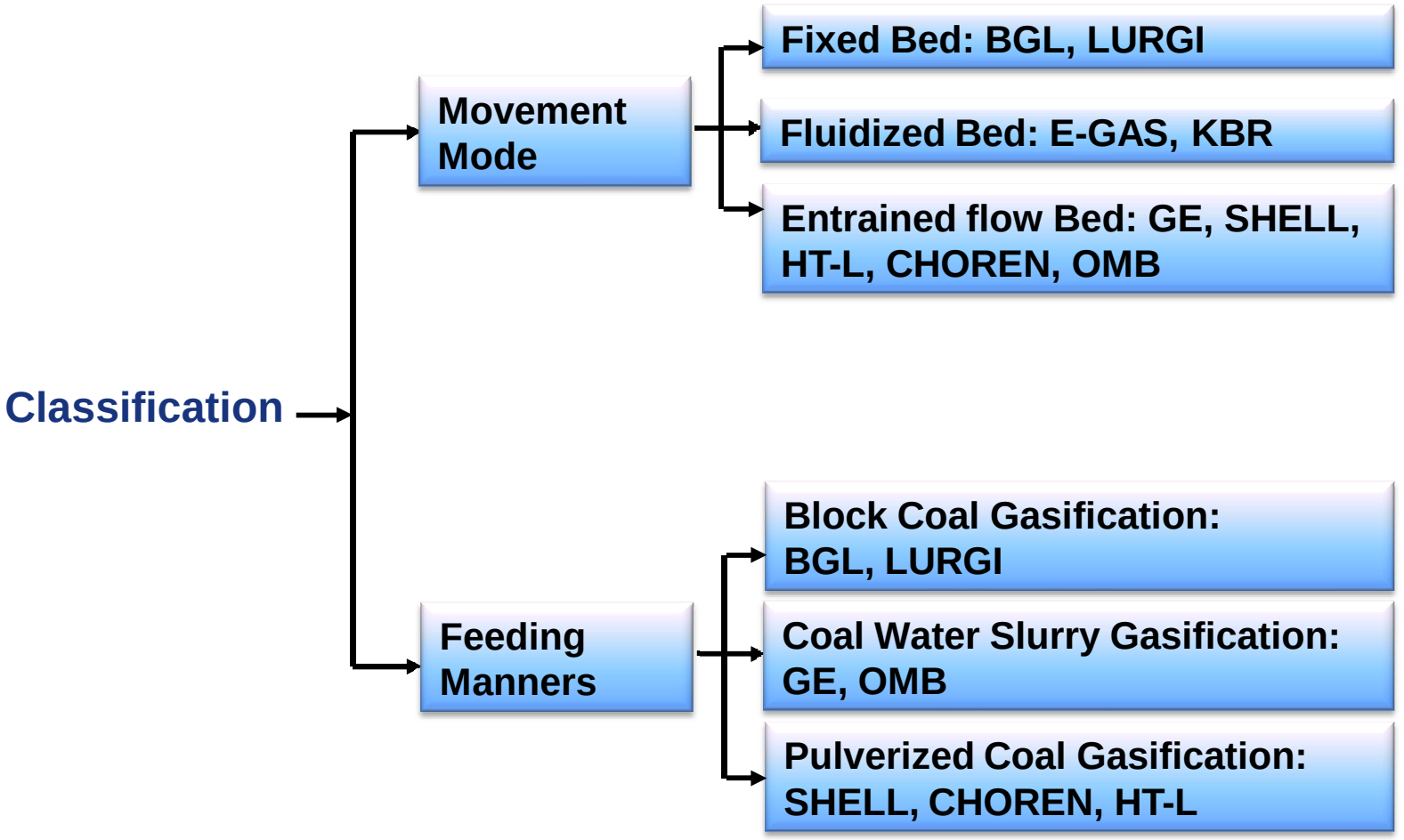
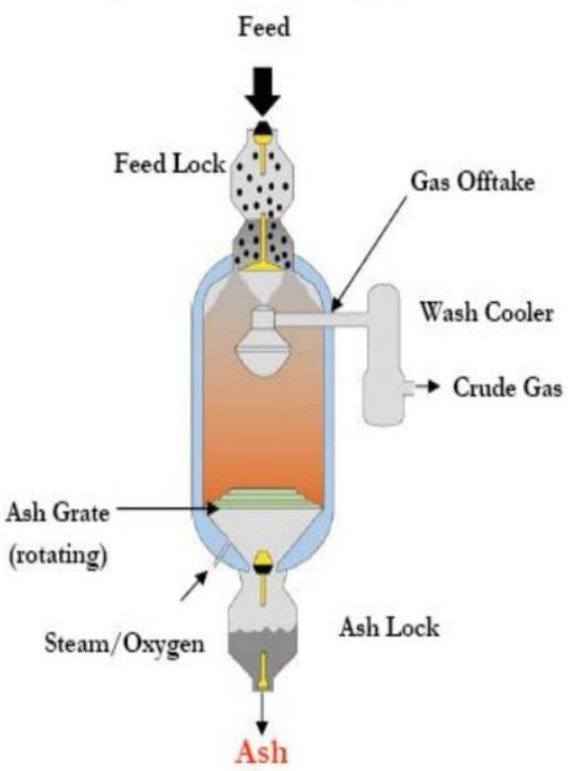
2、Introduction of Coal Gasification Technologies

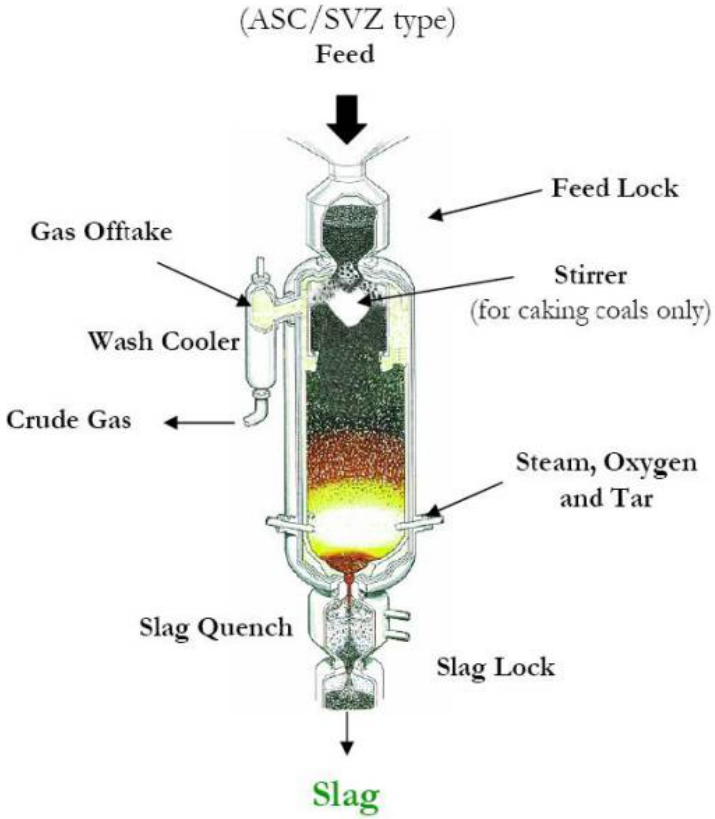


2、Introduction of Coal Gasification Technologies

Block Coal Gasification



LURGI Gasifier



BGL Gasifier

2、Introduction of Coal Gasification Technologies

Block Coal Gasification

- Wide adaptation range to coal: Petroleum coke, anthracite, bituminous coal, sub-bituminous coal, lignite and their mixed feeds;
- Suitable for weak broken coal with size range of 6-50mm;
- Oxygen and steam are used as gasification agents;
- Solid slag removal process: the operating temperature is 800~900 ^{o}C;
- Liquid slag-removal process: the operating temperature is 1300~1600 ^{o}C;
- the operating pressure is 2.5~4.0 MPa;
- High maintenance cost and complex structure of gasifier;
- Long process of downstream gas purification and waste water treatment because of tar, phenol components in raw gas.

2、Introduction of Coal Gasification Technologies

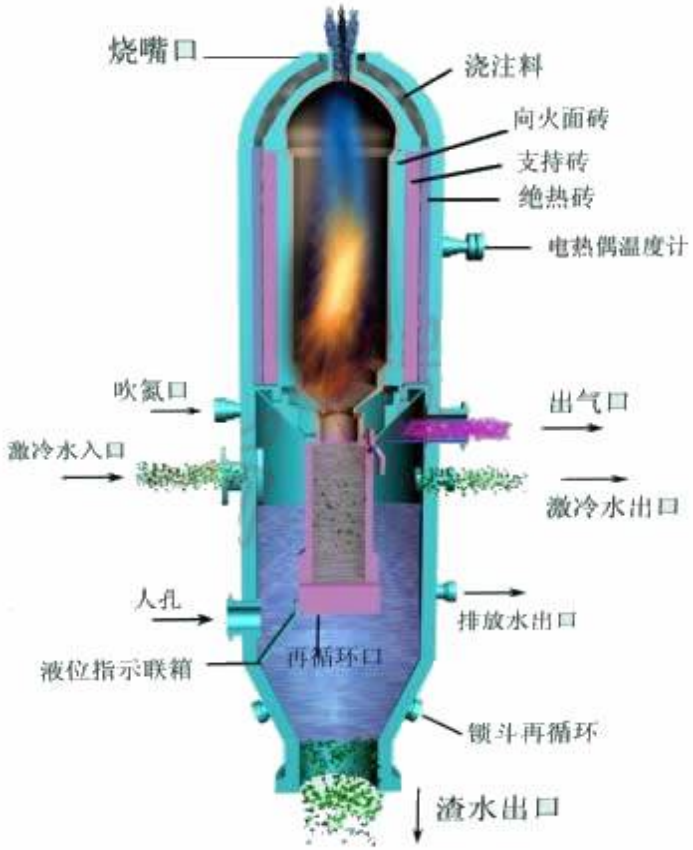
Block Coal Gasification

	Lurgi		BGL	
	ITEM	mol%	ITEM	mol%
Typical raw gas composition	H2:	39.5	H2:	25.74
	CO:	15.6	CO:	60.83
	CH4:	11.9	CH4:	7.8
	CO2:	31.57	CO2:	4.63
	N2:	0.1	N2:	0.19
	Ar:	0.05	Ar:	0.1
	NH3:	0.42	NH3:	0.06
	H2S:	0.14	H2S:	0.17
	COS:	0.02	COS:	0.03
	tar:	0.7	phenol	0.05
			tar	0.38

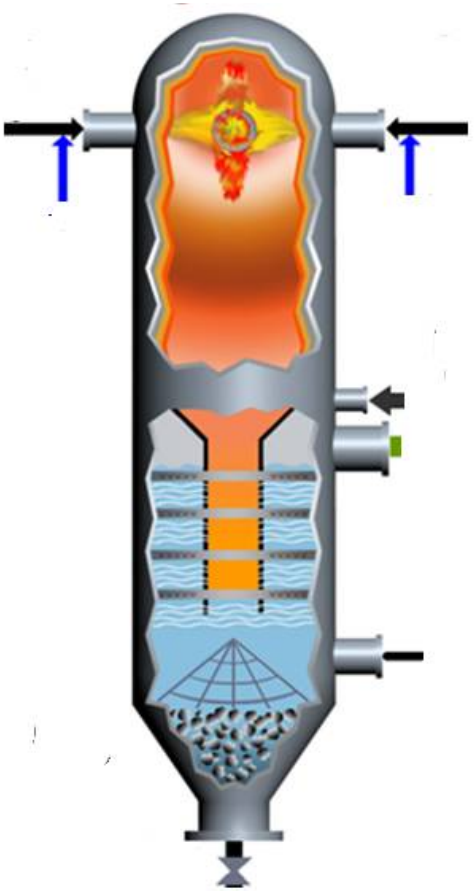
The complex composition of raw gas makes it not suitable for coal-syngas-chemical project. However, it is a preferred solution for coal to SNG projects due to the high methane fraction in raw gas. In the long term, these two technologies are still competitive in coal to SNG field.

2、Introduction of Coal Gasification Technologies

Coal Water Slurry Gasification Technology



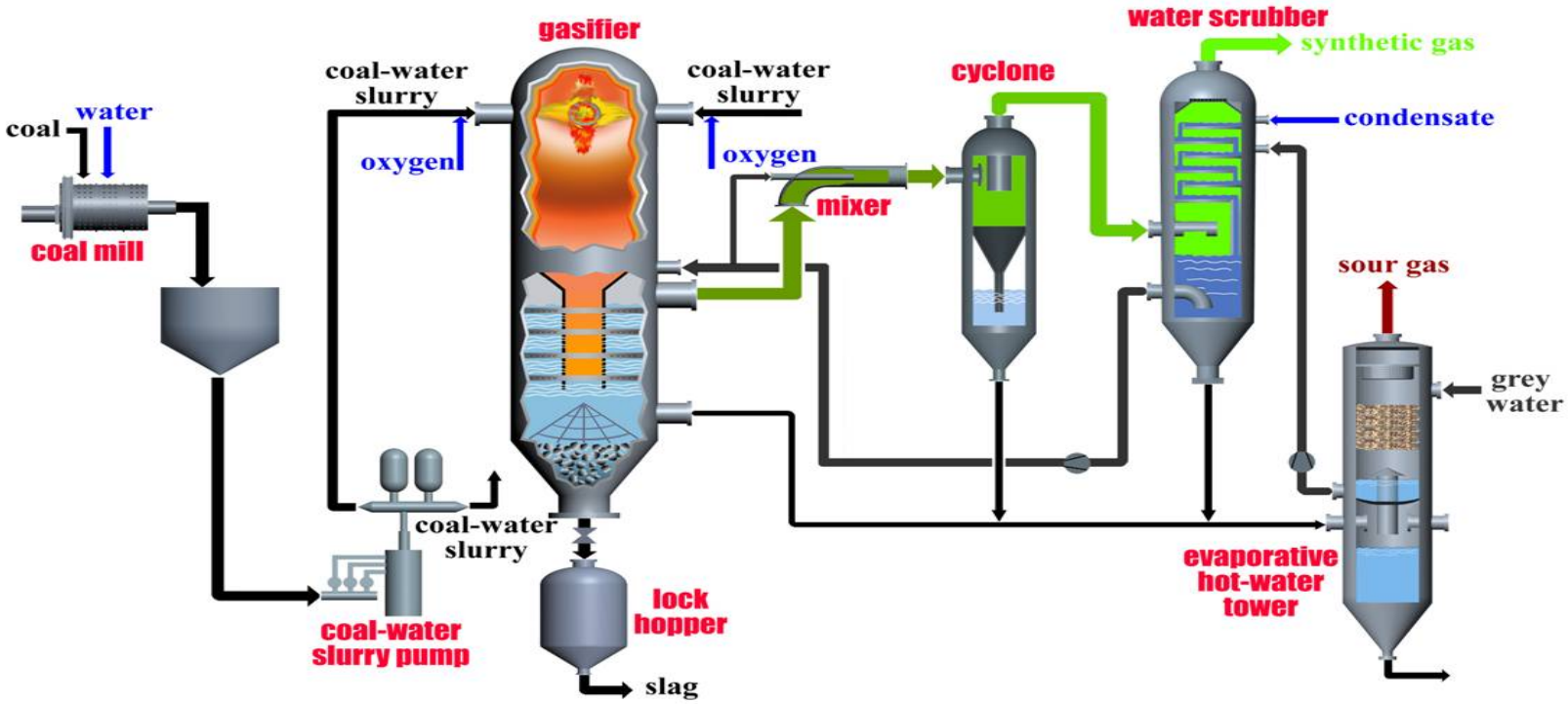
GE Gasifier



OMB Gasifier

2、Introduction of Coal Gasification Technologies

Coal Water Slurry Gasification Technology



Opposition Multi Nozzles (OMB) Gasification Process
Co-developed by Yankuang Group, ECUST and Tianchen Engineering Corporation

2、Introduction of Coal Gasification Technologies

Coal Water Slurry Gasification Technology

- Limit adaptation to coal: Bituminous coal, anthracite, petroleum coke with ash fusion point < 1350℃ and ash <19%; Slurry concentration > 58~60%;
- Simple structure of gasifier, high gasification intensity (~1500 ºC)
- Small equipment volume, compact layout, and large production capacity (4.0~6.5 MPa);
- Large coal gasify capacity: **3000 t/d**
- Continuous feeding and liquid slag discharge;
- High carbon conversion rate can reach 98%;
- High effective gas fraction: ≥80% (v% dry gas);
- Environmental friendliness: less external discharge due to waste water was reused for slurry preparation. Solid residue was used for construction material production.

2、Introduction of Coal Gasification Technologies

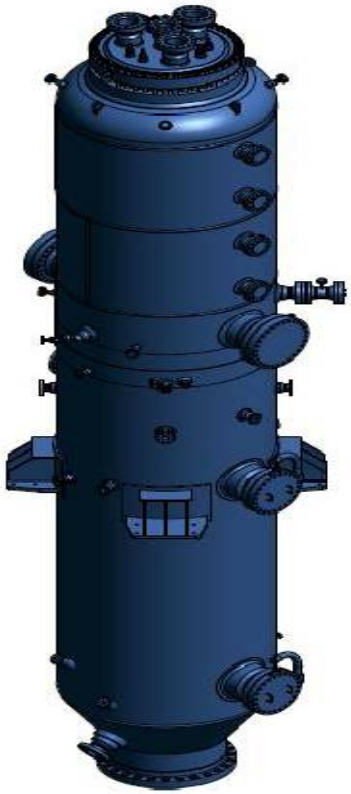
Coal Water Slurry Gasification Technology

	OMB		GE	
	ITEM	mol%	ITEM	mol%
Typical raw gas composition	H2	36.611	H2	36.323
	CO	44.665	CO	38.284
	CO2	17.159	CO2	23.426
	N2	0.583	N2	0.305
	H2S	0.715	H2S	0.65
	CH4	0.052	CH4	0.1
	NH3	0.085	COS	0.026
	COS	0.012	AR	0.121
	AR	0.118		

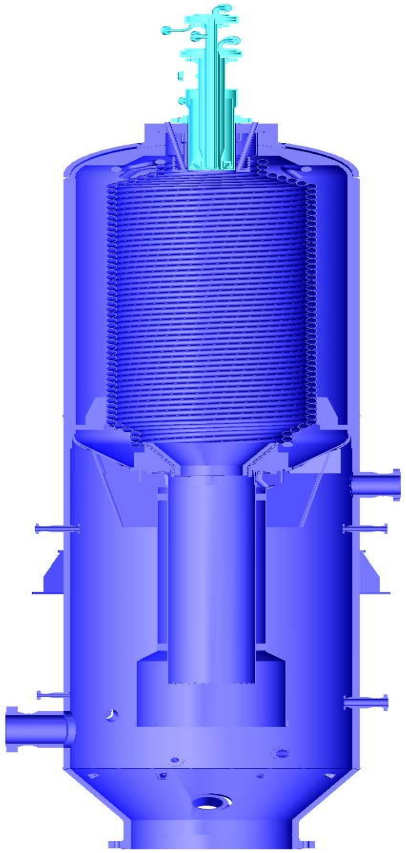
Coal water slurry gasification has been a mature technology presently. It is widely used in many coal-syngas-chemical projects. However, high requirements for coal quality limit the further promotion.

2、Introduction of Coal Gasification Technologies

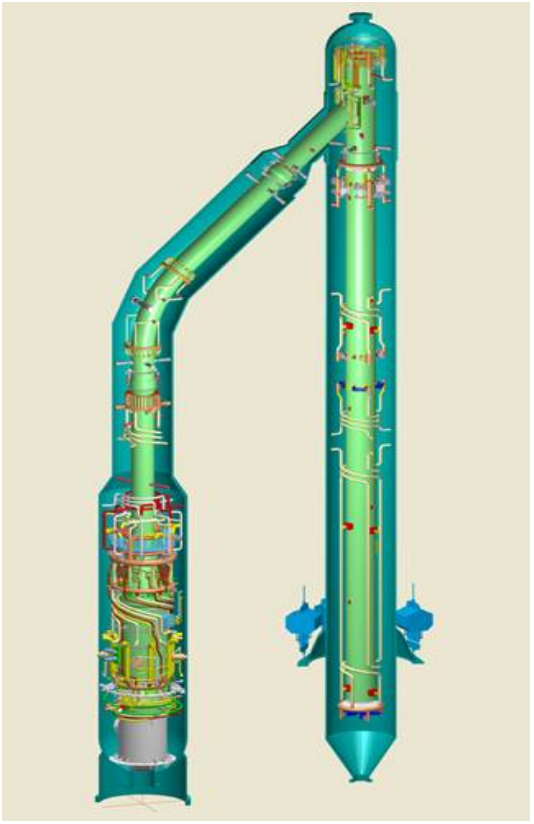
Pulverized Coal Gasification Technology



CHOREN CCG Gasifier



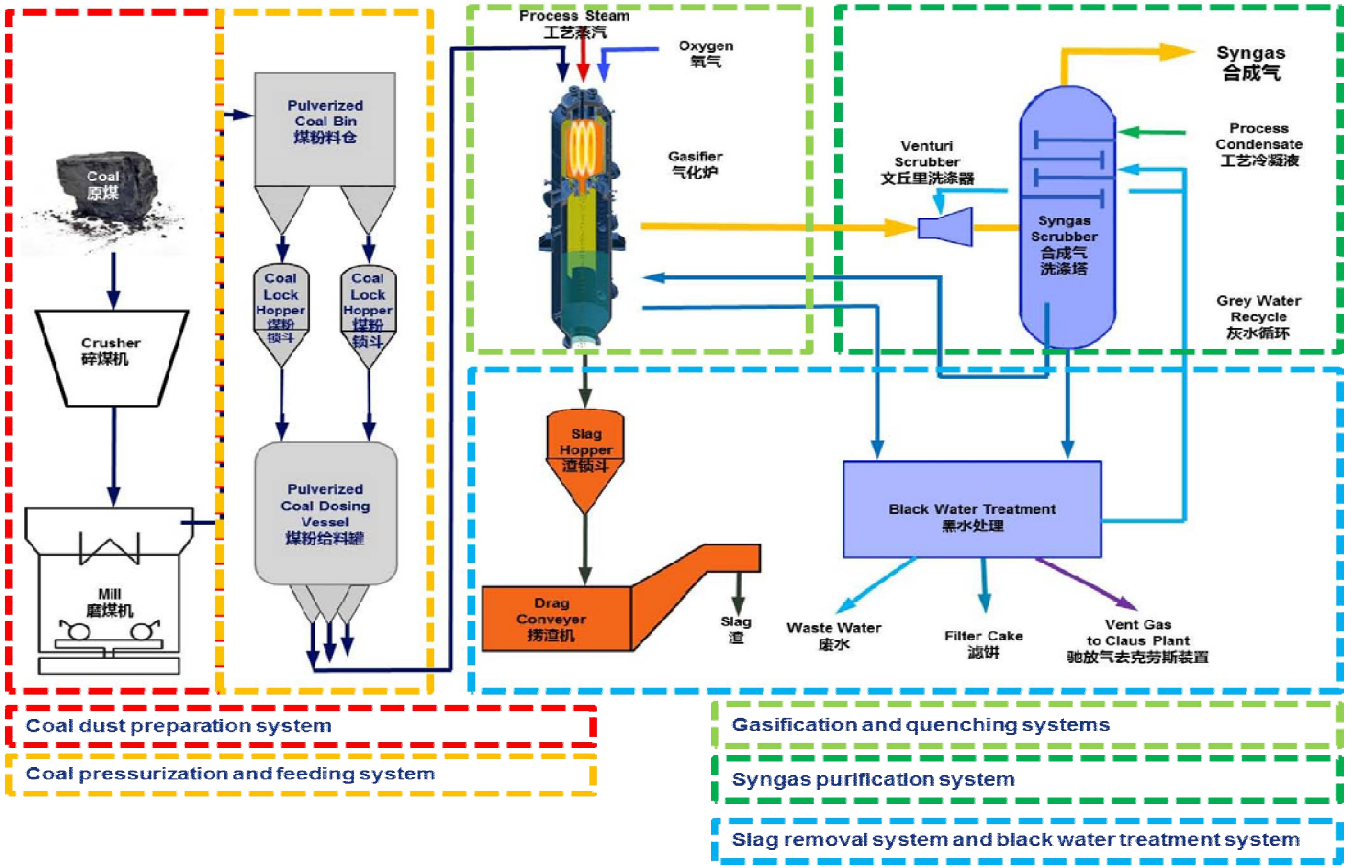
HT-L Gasifier



SHELL Gasifier

2、Introduction of Coal Gasification Technologies

Pulverized Coal Gasification Technology



CHOREN Gasification Process

2、Introduction of Coal Gasification Technologies

Pulverized Coal Gasification Technology

- Wide adaptation to different raw materials including bituminous coal, anthracite, lignite and petroleum coke, and also including high ash, high sulfur, high ash melting point coal;
- Water wall structure can withstand the high temperature of 1500 oC. Compared with coal water slurry gasifier, it has a long lifetime, and convenience on maintenance which avoid the high cost and shutdown due to the regular replacement of refractory bricks;
- High thermal efficiency (up to 95%) and carbon conversion (up to 99%);
- High quality of raw gas makes it suitable for coal to chemical project.

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3、Challenges in Coal Chemical Industry

- The correct selection of gasification technology is a prerequisite for the success of a project. At present, there is no certain gasification technology which is completely suitable for all projects. Any choice advantages and disadvantages. Especially for projects with lignite as raw material, the gasification technology selection is more limited. The choice of gasification should be based on the type of raw material, product scheme. And the balance of reliability, energy efficiency and economy feasibility should be determined.
- Considering environmental policies, the water-saving scheme and waste water treatment system are of great importance.

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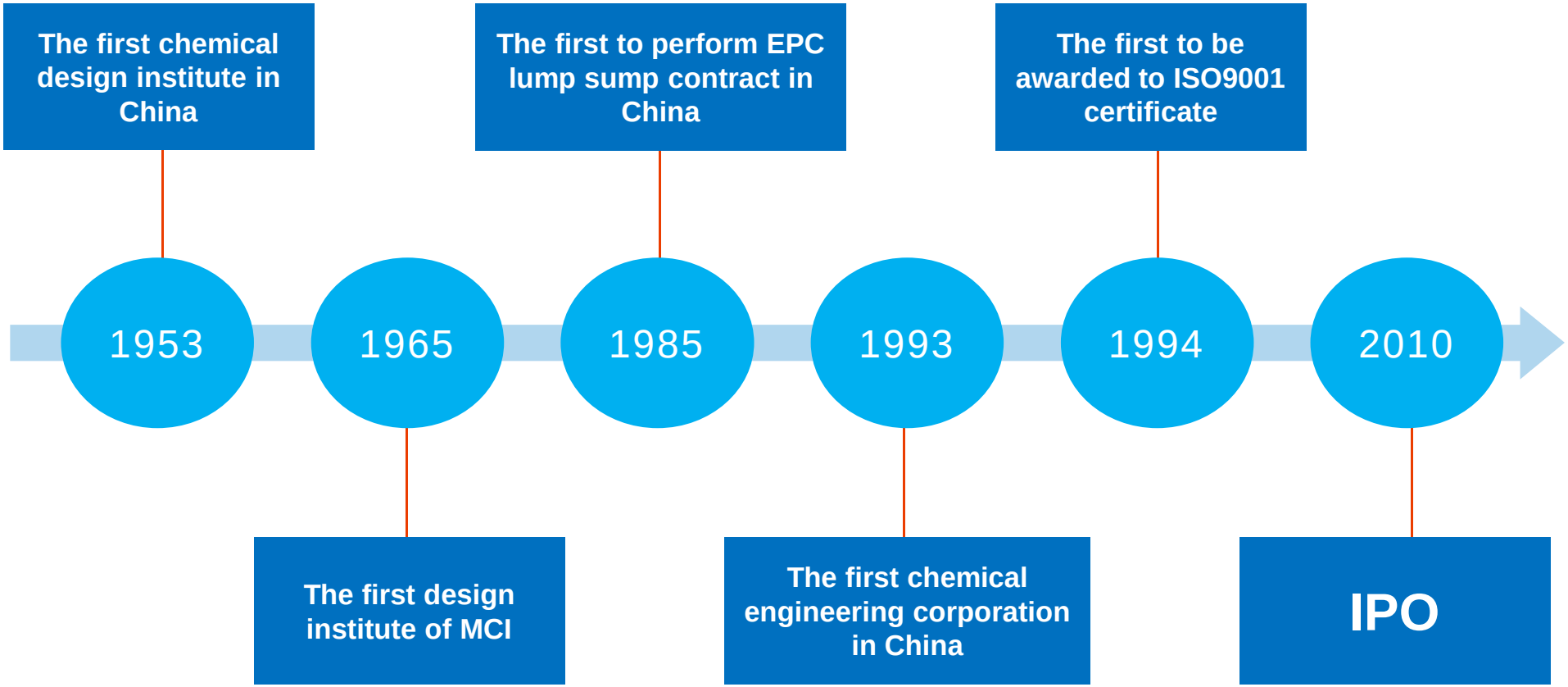
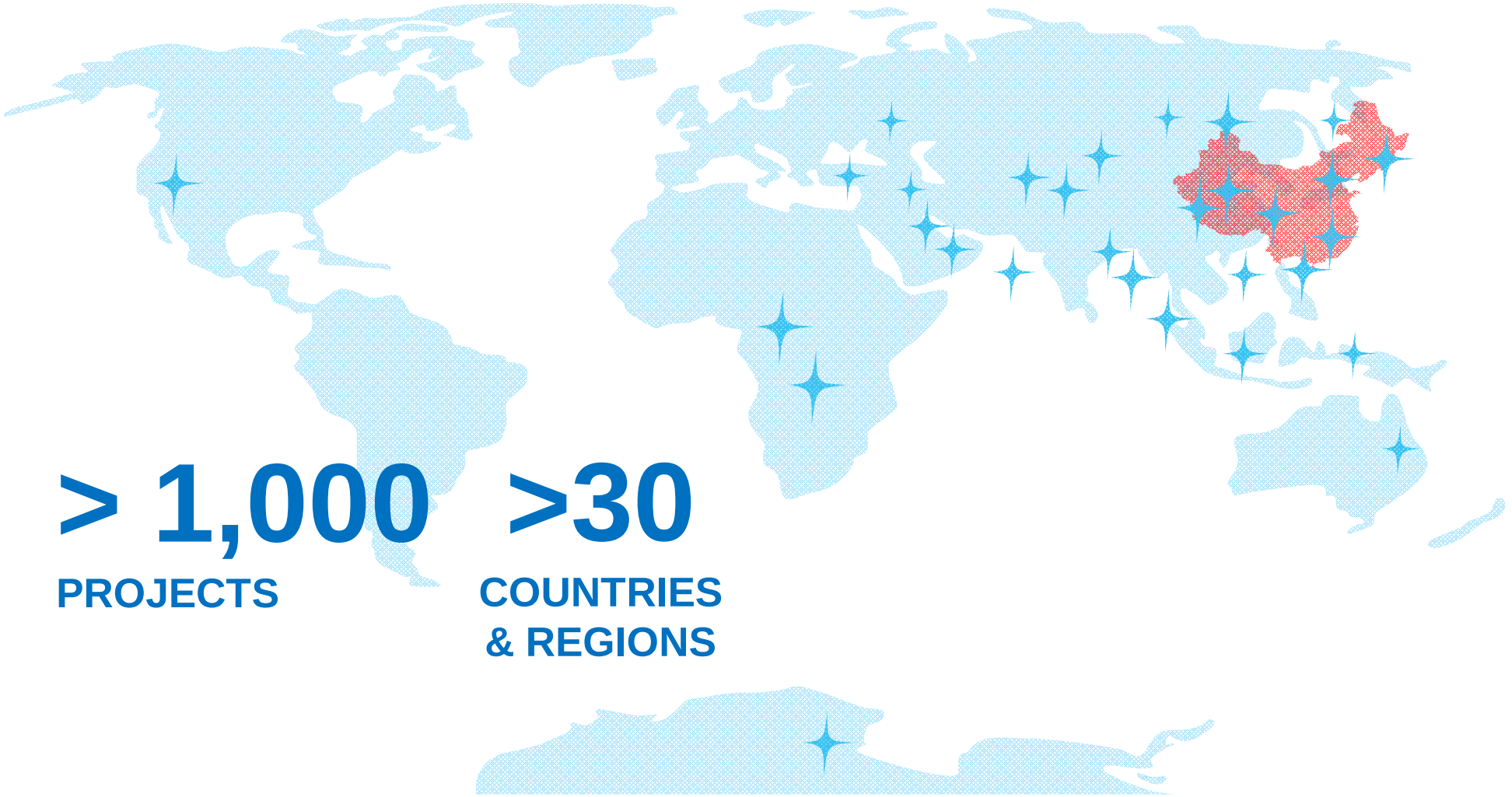
4.1、Development History



4、Achievement of TCC in Coal Chemical Industry

4.2、Foot Print



> 1,000
PROJECTS

>30
COUNTRIES & REGIONS

4、Achievement of TCC in Coal Chemical Industry

4.3、Service Area

FRONT PHASE

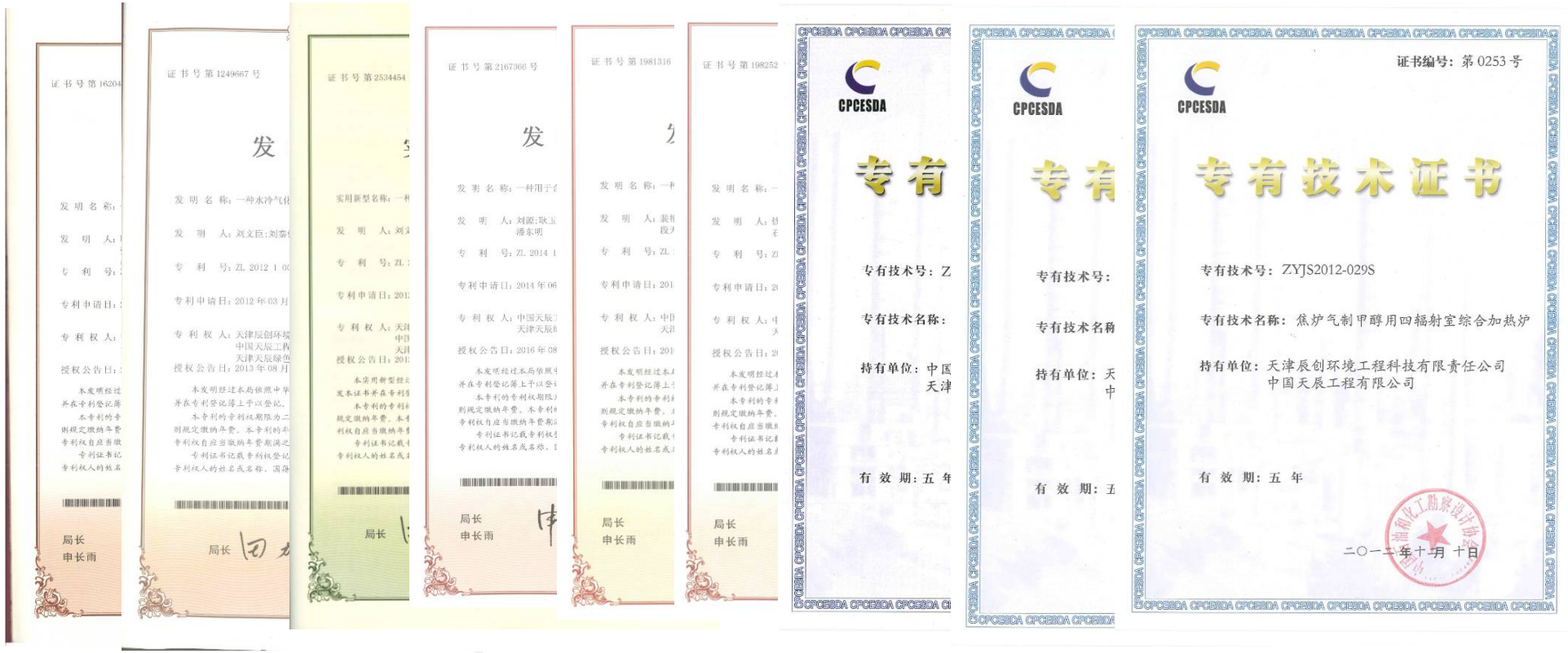
BUSINESS PLANING	DEFINITIVE PLANNING	FEED
DEFINITION	DEVELOPMENT	

IMPLEMENTATION PHASE

DETAILED ENGINEERING PROCUREMENT & CONSTRUCTION	COMMISSIONING STARTUP & MAINTENANCE
EXECUTION	COMPLETION

4、Achievement of TCC in Coal Chemical Industry

4.4、Patents and Proprietary Technologies



More than 41 patents and 9 proprietary technologies in coal chemical industry.

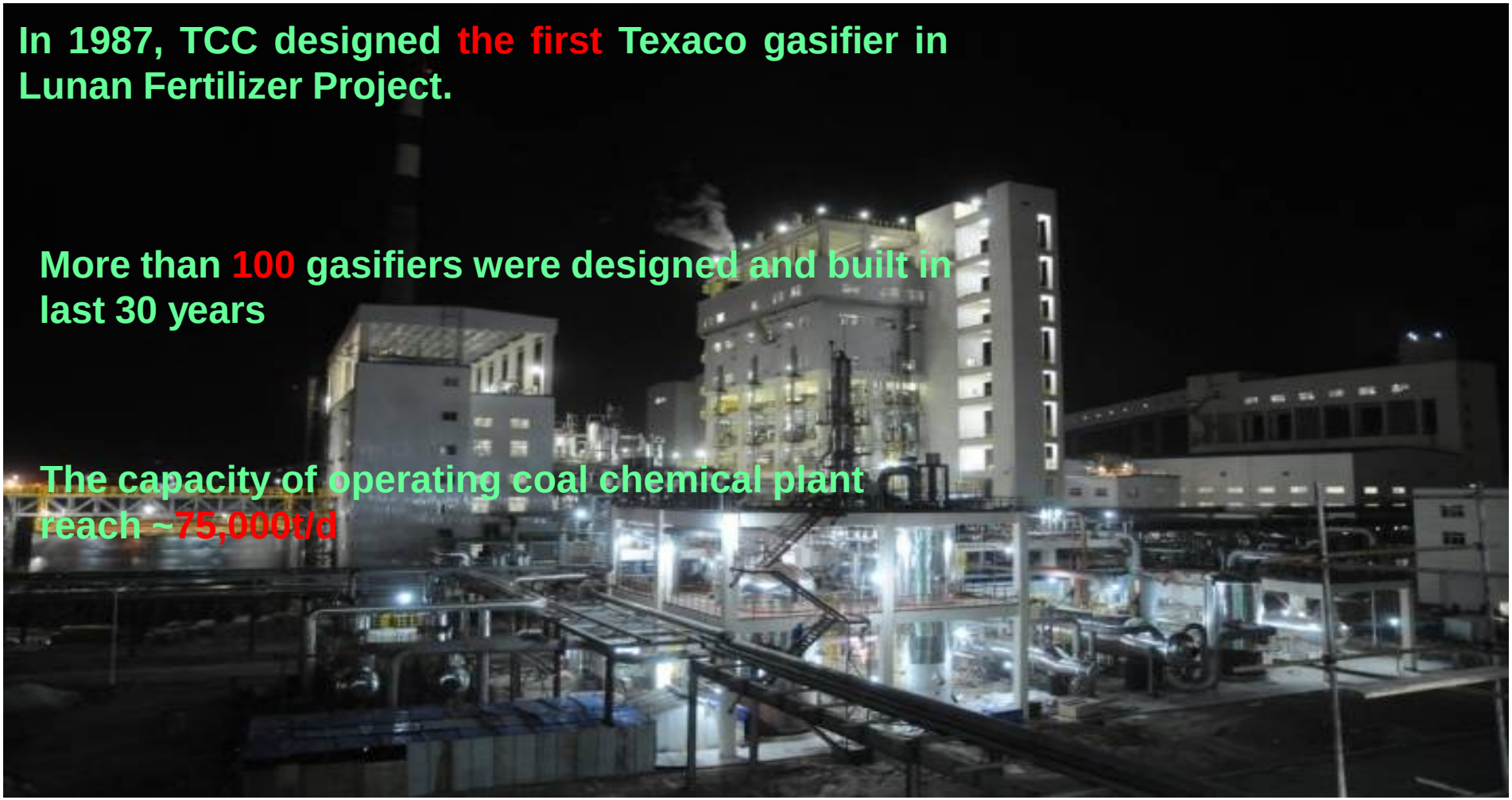
4、Achievement of TCC in Coal Chemical Industry

4.4、Patents and Proprietary Technologies

- OMB Coal Slurry Pressurized Gasification Technology
- Pulverized Coal Pressurized Gasification Technology
- Coking-oven Gas to Methanol Technology
- Syngas Heat Recovery Equipment Research in IGCC-Integrated Gasification Combined Cycle
- Drying and Re-forming Technology of Lignite
- Waste Water Treatment of Coal Chemical Plant

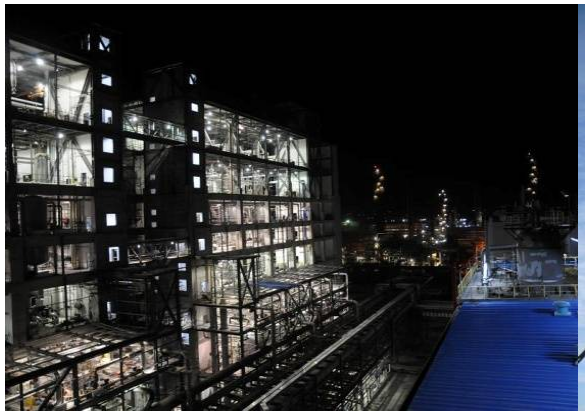
4、Achievement of TCC in Coal Chemical Industry

4.5、Reference-Plant-First Gasification Plant



4、Achievement of TCC in Coal Chemical Industry

4.5、Reference Plant-Coal to Olefin



SHENHUA (BAOTOU) MTO PROJECT

Production Capacity：

1,800,000 t/a Methanol，

600,000 t/a Olefin

Completion date: 2009.11

Total investment：18.8 Billion RMB

Contract amount：3.5 Billion RMB

TCC Scope：EPC for Gasification and Whole Plant Utilities

Project feature：The first and biggest demonstration Coal to Olefin project in the world.

4、Achievement of TCC in Coal Chemical Industry

4.5、Reference Plant-Coal to Oil

4、Achievement of TCC in Coal Chemical Industry

4.5、Reference Plant-Coal to SNG

4、Achievement of TCC in Coal Chemical Industry

4.6、Technical cooperation

Air Separation	AIR LIQUIDE WELDING, Linde, AIR PRODUCTS, 杭氧 Hang Yang
Gasification	GE, CHOREN, EAST CHINA UNIVERSITY OF SCIENCE AND TECHNOLOGY, SES SYNTHESIS ENERGY SYSTEMS
Rectisol	Linde, Lurgi, DALIAN UNIVERSITY OF TECHNOLOGY 1949
Methanation	Davy Process Technology, HALDOR TOPSØE
Methanol Synthesis	HALDOR TOPSØE, Davy Process Technology, Lurgi, CASALE
Others	UOP A Honeywell Company, Shell, SIEMENS

4、Achievement of TCC in Coal Chemical Industry

4.7、Rich Experience

THANKS!