Temperi Logistics Ltd

Development of both Bulgarian Energetics and Economy in progress on the basis of local lignite deposits' utilization

Overview of the status, problems, prospects, sources of information

February 1st, 2022

Based on public sources - may contain inaccuracies and is not exhaustive

The authors invite interested persons to join in the purpose of the review

Contents

1. Introduction

The objectives of this review are to provoke a discussion on the preservation of the coal industry of the Republic of Bulgaria in the 21st century, to indicate and to point out the modern technologies of lignite processing.

The reserves of Bulgarian brown coals - lignites are estimated at 2.1 billion tons.

The volume of lignite production in Bulgaria is 25 million tons per year and can be increased up to 35 million tons per year.

Thus, the reserves would be sufficient for 65 years.

Currently, Bulgarian lignites are used as fuel for 4-coal CHP plants and provide 25% of the country's energy balance.

Mining of 90% of lignites in Bulgaria is carried out at the Maritsa Iztok Coalfield (https://www.marica-iztok.com/en/) deposit in the administrative region of Stara Zagora.

The production is carried out by the Joint Stock Company “Mini Maritsa Iztok” - in 3 open-pit mines. The number of staff is 7 050 people.

Indicator, million euros	2019	2020	9 mo. 2021
Income	257	231	203
Profit / (Losses)	0,6	(17,4)	5,3

100% of shares of “Mini Maritsa Iztok” are owned by the state. The production is carried out under a 35-year concession issued in 2005.

Since 2008 JSC "Mini Maritsa Iztok" is a subsidiary of the Joint Stock Company "Bulgarian Energy Holding" (https://bgenh.com/), 100% owned by the state. The holding includes, among others, a CHP and a Briquette Factory.

The holding staff is 20 386 people.

Consolidated indicators of the holding.

Indicator, million euros	2019	2020	6 mo. 2021
Income	3 371	2 798	1 395
Profit / (Losses)	199,5	78,5	86

Since 2013, the Bulgarian Energy Holding has been placing financial instruments - bonds on the European stock exchanges. In total, there are bonds in circulation for 4.850 billion euros with a yield of 2.45 - 4.9%.

EU environmental programs provide for the termination of the operation of coal-fired CHP plants until 2030.

Dependence on lignite for the economy of Bulgaria and neighboring countries.

https://euracoal.eu/info/country-profiles/

Countries	Lignite reserves, mln. tons	Lignite mining, mln. tons per year	Personnel engaged in lignite mining, persons.	Electricity production from lignite, %
Bulgaria	2 100	25	7 050	25
Bosnia and Herzegovina	2 300	14	3 500	62
Greece	2 900	36	6 100	29
Kosovo	10 800	7	1 000	93
North Macedonia	2 000	31	13 000	25
Romania	632	5	800	50
Serbia	7 000	38	14 800	70

Currently in the world there exist and have been implemented **technologies of complex processing of coals** based on gasification processes on an industrial scale.

The world leader in this technology is China. Notable results have been achieved in India.

Scientific and engineering solutions - Germany, USA, Japan.

Financial investment models: funds, stock exchange, large corporations, consortia.

Winkler's standard lignite gasification plants achieve:

- temperature 1100 degrees Celsius;
- pressure 3 MPa;
- capacity for coal 42 tons / hour or 300,000 tons per year;
- thermal efficiency 70%;
- degree of conversion of carbon 95%.

As a result of gasification within one industrial site at several plants with a total capacity of up to 1 million tons per year of coal on an industrial scale is produced:

- synthetic gas for power plants;
- solid, liquid and gaseous products for the chemical industry;
- by-products that pollute the environment.

The total capacity of gasifiers currently operating in the world is 1 billion tons of coal per year.

2. Products of complex processing of coals:

- Synthesis gas;
- Coke and semi-coke;
- Coal-tar pitch;
- Benzene, naphthalene, anthracene, phenanthrene;
- Cresols, phenol, pyridines, anthracene oil;
- Methanol;

- Gasolines;
- Gas oil;
- Fuel additive;
- Diesel fuel;
- Various adhesives;
- Gases - helium, ammonia and hydrogen;
- Insulation materials;
- Formaldehydes;
- Acetic acids;
- Mineral fertilizers;
- Waxes;
- Plastics;
- Vaseline;
- Polypropylene;
- Polyethylene;
- Activated carbon and sorbents;
- Paint coatings.

3. Problems of complex coal processing:

a) capturing greenhouse gases;

b) gas cleaning;

c) removal of gasification by-products;

d) specialization of gasifiers, namely –

The design of gasifiers and the process mode of gasification must be optimized:

- for the chemical and mineral composition of coals;
- depending on the end products;
- depending on the technology of processing of intermediate products.

e) The problem of industrial scaling, namely, successful laboratory and pilot industrial-engineering solutions do not guarantee the technological and economic feasibility of processes in large-scale mass production of a continuous cycle.

The economic effect of coal gasification is based on the price of natural gas in the global and local markets.

With the price of natural gas at 250 USD per 1,000 cubic meters, coal gasification is economically feasible.

4. Capital Cost

a) The cost of an industrial facility for integrated coal processing with a capacity of 1 million tons per year of coal is 1.2 billion USD.

Before being fed to the gasifier, the raw material must be prepared - normalized in terms of fraction and moisture.

As part of the comprehensive coal processing facility are financed:

- Coal preparation section;
- Gasifiers - up to 4 units;
- Power plant;
- Chemical production;
- Installations of environmental protection;
- Transport infrastructure;
- Industrial laboratory;
- Working capital before reaching design capacity, necessary to create reserves.

b) The power plant, which runs on gas obtained as a result of gasification, is equipped with gas turbines.

Power plants cost:

400 MW - 165 million USD, 400 MW - 290 million USD.

c) The cost of a plant for the production of chemical products from gasification products is 100-200 million USD.

5. Sources of investment for complex processing of coals:

a) Manufacturers of equipment for complex coal processing;

b) Leasing companies;

c) Investment funds, including specialized state ones;

d) EU Targeted Funding;

e) The financial instruments of the stock exchange - bonds;

f) Consortium of multiple sources.

Return on investments is 25 years.

6. Stages of implementation of the Program of Integrated Coal Processing in Bulgaria:

a) Creation of a working group at the Chamber of Commerce and Industry.

Press release - 3 months;

b) Public discussion of the Program. Competition for student and engineering work with an overview of the current state of technology. 6 months;

c) Creation of a specialized laboratory. Cost of equipment and experiments $ 5 million. Significant results in 2 years;

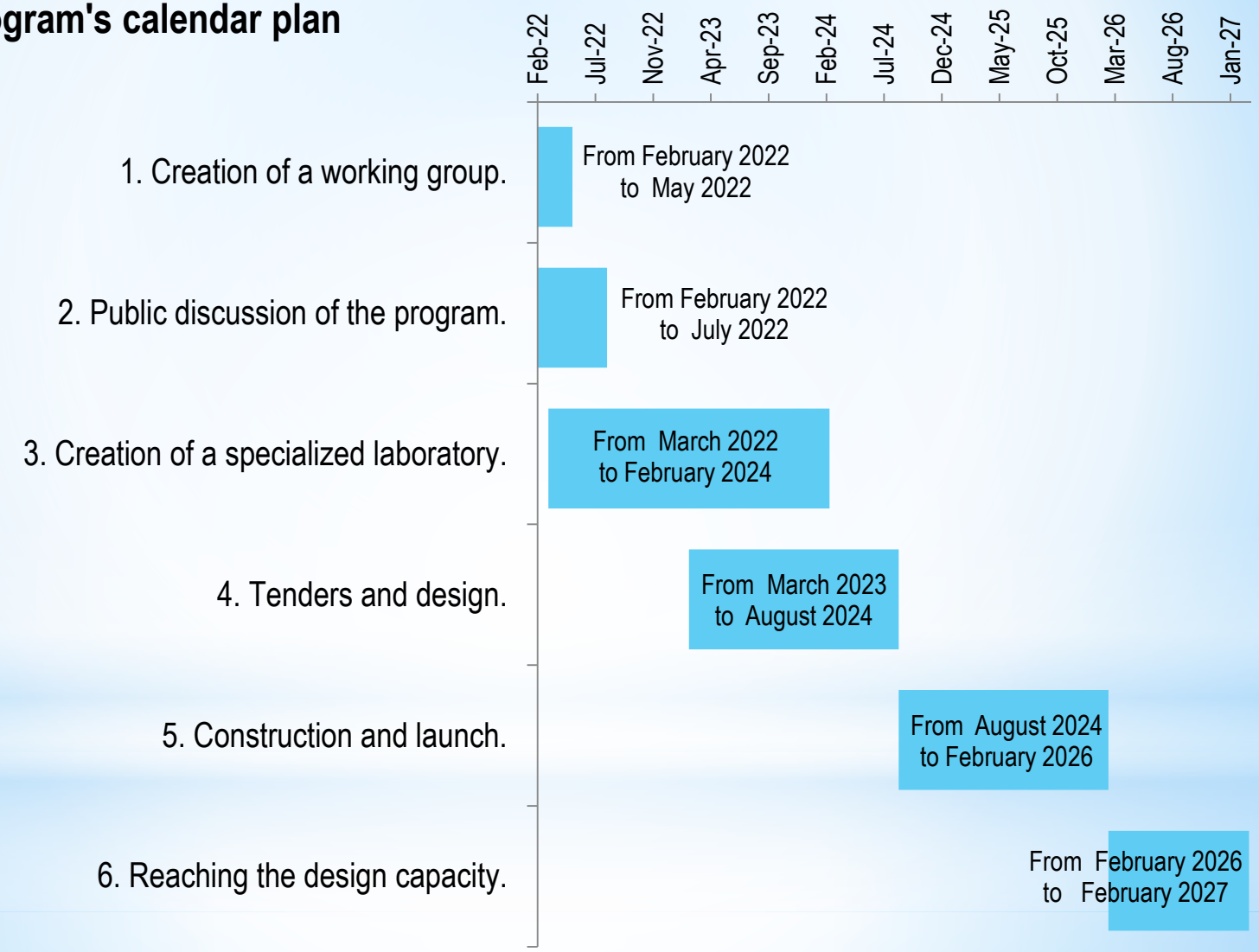
d) Tenders for investments, design work, supply of gasifiers, plants and equipment in various areas of technology. 1.5 years;

e) Construction and installation 1.5 years;

f) Reaching the design capacity in 1 year;

g) Program's calendar plan.

The Program's calendar plan



Thus, five years after the start of the Program Bulgaria:

a) Will receive 2-3 industrial facilities for integrated processing of local lignites with a total capacity of up to 5 million tons of coal per year.

b) Gain experience, namely:

- engineering structure;
- financial and commercial model.

On the basis of the Bulgarian infrastructure, it will be possible to implement similar projects in other regions (the countries of the Balkans, Africa).

c) Up to 5,000 new jobs will be created in Bulgaria.

d) Bulgaria will keep 7 200 existing jobs in lignite mining.

7. Supporting programs

European project "The Future of Coal".

Published 3 reviews – https://coaltech2051.eu/

EU Specialized Fund Research Fund for Coal and Steel.

Foundation projects on related topics pp. 33-43.

https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/research-fund-coal-and-steel-rfcs_en#goal

It should be noted the absence of projects on gasification of lignite.

https://ec.europa.eu/info/sites/default/files/research_and_innovation/funding/documents/synopsis_of_rfcs_projects_2017-2020.pdf

8. Patent search

a) Results of a Google Search Patent Patent search for Coal +Gasification with activation of the search by scientific paper.

https://patents.google.com/?q=coal%2bgasification&scholar&oq=coal%2bgasification

135 829 results, including 19 major patent holders:

1	Xinao Technology Development Co., Ltd.	5.3%	7 199
2	Mitsubishi Heavy Industries Co., Ltd.	2.9%	3 939
3	China Petroleum & Chemical Corporation	1.9%	2 581
4	Xin'ao Gasification Coal Mining Co., Ltd.	1.9%	2 581
5	The United States Of America As Represented By The United States Department Of Energy	1.6%	2 173
6	South China University of Technology	1.4%	1 902
7	East China University of Science and Technology	1.2%	1 630
8	General Electric Company	1.1%	1 494
9	Shenhua Group Co., Ltd.	1.1%	1 494
10	Taiyuan University of Technology	1.1%	1 494
11	China Huaneng Group Clean Energy Technology Research Institute Co., Ltd.	1.1%	1 494
12	Southeast University	1.1%	1 494
13	Power Development Co., Ltd.	1%	1 358
14	Central Research Institute of Electric Power	1%	1 358
15	Harbin Institute of Technology	1%	1 222
16	Hitachi, Ltd.	0.9%	1 222
17	Exxon Research & Engineering Co.	0.9%	1 222
18	Hitachi Manufacturing Co., Ltd.	0.8%	1 087
19	Institute of Engineering Thermophysics, Chinese Academy of Sciences	0.8%	1 087
	Total	**28%**	**38 032**

b) Results of a Google Patent Search Patent search for Lignite + Gasification.

https://patents.google.com/?q=lignite%2bgasification&scholar&oq=lignite%2bgasification

86 248 results, including 19 major patent holders:

Yunnan Tianjiao Industry and Trade Co., Ltd.	0.4%
China Tianchen Engineering Co., Ltd.	0.4%
Tianjin Tianchen Green Energy Engineering Technology R&D Co., Ltd.	0.4%
China Petroleum & Chemical Corporation	0.2%
Rheinische Braunkohlenw Ag	0.2%
Koppers Gmbh Heinrich	0.1%
China Petroleum & Chemical Corporation Shanghai Research Institute of Petrochemical Industry	0.1%
MCC Jingcheng Engineering Technology Co., Ltd.	0.1%
Wang Xiaofeng	0.1%
Chen Yuansheng	0.1%
Isentropic Systems Ltd.	0.1%
Beijing Jingcheng Zeyu Energy Environmental Engineering Technology Co., Ltd.	0.1%
Mile County Ruiyuan Nonferrous Metals Co., Ltd.	0%
Taiyuan University of Technology	0%
Alfred Weymann	0%
Steinkohlenkokereien August Be	0%
Anhui Zhuoxin Clean Energy Technology Co., Ltd.	0%
Kovalenko Vorokimir	0%
Institute Of Gas Technology	0%

9. Photos of facilities

a) Two-stage gasifier. India.

Naltern Technologies Pvt. Ltd
https://www.indiamart.com/naltern-technologies/know-us.html

Kathwada, Ahmedabad, Gujarat
https://www.google.co.in/maps/dir//23.0459594,72.6818441

b) Coal Gasification Plant in China.

Lu'an coal gasification project located in Shanxi Province

https://www.airproducts.com/company/news-center/2018/11/1101-air-products-luan-coal-gasification-project-in-china-fully-onstream

10. Publications:

a) Coal gasification: The clean energy of the future?, 2014
Richard Anderson,Business reporter, BBC News
https://www.bbc.com/news/business-26921145

b) Commercial examples of gasification-based chemicals production
National energy technological laboratory
https://netl.doe.gov/research/coal/energy-systems/gasification/gasifipedia/commercial-production

c) Indonesia clings to coal despite green vision for economy, 2021
Fransiska Nangoy and Gayatri Suroyo
https://www.reuters.com/business/energy/indonesia-clings-coal-despite-green-vision-economy-2021-09-20/

d) Multi-purpose Coal Gasification Technology Development (EAGLE)
New Energy and Industrial Technology Development Organization;
J-POWER; Japan Coal Energy Center; and Babcock Hitachi K.K.
http://www.jcoal.or.jp/eng/cctinjapan/2_2B3.pdf

e) Hirono IGCC Plant Construction Project Completed in Fukushima;
Operations Launched on November 19

New Facility Created to Enhance Local Industrial Infrastructure and Boost Regional Recovery, 2021
Mitsubishi Heavy Industries Group
https://www.mhi.com/news/211124.html?fbclid=IwAR064Y3iS7qpjVw_hujQjyZezbLd5CJ1s-5P7pMeFVxTtoaBN92g_2KHwEw

f) An evaluation of Substitute natural gas production from different coal gasification processes based on modeling, 2012
S.Karellas, K.D.Panopoulos, G.Panousis, A.Rigas, J.Karl, E.Kakaras
https://www.sciencedirect.com/science/article/abs/pii/S0360544212002782

g) Coproduction of Electrical Energy and Methanol in IGCC Plants, 2018
Kamran Ghasemzadeh, Seyyed M.Sadati Tilebon, Angelo Basile
https://www.sciencedirect.com/science/article/pii/B9780444639035000157

h) Synthesis gas production with an adjustable H2/CO ratio through the coal gasification process: effects of coal ranks and methane addition, 2008
Yan Cao, Zhengyang Gao, Jing Jin, Hongchang Zhou, Marten Cohron, Houying Zhao, Hongying Liu, and Weiping Pan

https://www.researchgate.net/profile/Wei-Ping-Pan-2/publication/231273313_Synthesis_Gas_Production_with_an_Adjustable_H2CO_Ratio_through_the_Coal_Gasification_Process_Effects_of_Coal_Ranks_And_Methane_Addition/links/5ca6a22092851c64bd50b307/Synthesis-Gas-Production-with-an-Adjustable-H2-CO-Ratio-through-the-Coal-Gasification-Process-Effects-of-Coal-Ranks-And-Methane-Addition.pdf

i) Combustion vs. gasification for a demonstration CCS (carbon capture and storage) project in Italy: A techno-economic analysis, 2013
Pettinau A, Ferrara F, Amorino C
https://patents.google.com/scholar/9010022674996317 2?q=lignite%2bgasification%2binvestment&scholar&oq=lignite%2bgasification%2binvestment&page=11

j) The economics of gasification: a market-based approach, 2009
Abadie L, Chamorro J
https://www.mdpi.com/1996-1073/2/3/662

11. Scientific and research centers with results, reviews and specialists on the topic

a) The US-China Energy Center of The Energy Institute at West Virginia University
https://uscec.wvu.edu/

b) The Institute of Coal Chemistry, China
http://english.sxicc.cas.cn/au/bi/

c) Thermal Power Research Institute, China
http://www.tpri.com.cn/synchrobit/tpriwebsite/en/overview.html

d) Tshinghua University, China
https://www.tsinghua.edu.cn/en/index.htm

e) Institute of Thermal Enginiaring, China
https://www.depe.tsinghua.edu.cn/depeen/Research1/Institute_of_Thermal_Engineering.htm

f) Paul Scherrer Institut, Switzerland
https://www.psi.ch/en/science

g) Technische Universität Bergakademie Freiberg, Germany
https://tu-freiberg.de/en
https://tu-freiberg.de/en/fakult4/iwtt

h) Università degli Studi di Roma "Tor Vergata«, Italy
http://web.uniroma2.it/en

i) ZSW, Germany
https://www.zsw-bw.de/en.html

j) Chalmers University of Technology, Sweden
https://www.chalmers.se/sv/Sidor/default.aspx

k) Montanuniversität Leoben, Austria
https://www.unileoben.ac.at/en/

l) Energy research Centre of the Netherlands
https://www.ecn.nl/energy-research/index.html

12. Industrial gasifier manufacturing companies and technology owners:

- Air Liquide / Lurgi GmbH

Fixed – Bed, Dry-Bottom Gasifier;

- EnvironTherm GmbH

British Gas Lurgi Slagging Gasifier (BGL);

- GenCorp / Pratt Whitney Rocketdyne

Dry-feed, Plug-flow, Entrained Gasifier;

- General Electric Energy

GE Direct Quench, Entrained Gasifier;

- Kellogg, Brown, & Root, Co.

Transport Integrated Gasifier (TRIG;

- Royal Dutch Shell/Shell Global Solutions International

Shell Coal Gasification Process (SCSP);

- Siemens AG

Siemens Fuel Entrained Flow (SFG) Gasifier;

- Synthesis Energy System

U-GAS Fluidized Bed Gasifier.

13. Abbreviations and acronyms

BGL	British Gas / Lurgi Slagging Gasifier	**NM^3/H**	Normal Cubic Meters per Hour
CO_2	Carbon Dioxide	**NM^3/Y**	Normal Cubic Meters per Year
CTL	Coal to Liquids	**NWRICI**	Northwest Research Institute of Chemical Industry
ECUST	East China University of Science and Technology	**SCFD**	Standard Cubic Feet per Day
GE	General Electric	**SNG**	Synthetic Natural Gas
H_2	Hydrogen	**TPD**	Tons per Day
HTL	Gasifier Developed by China Aerospace Science and Technology Corporation	**TPY**	Tons per Year
ICC/CAS	Institute of Coal Chemistry/China Academy of Science	**TPRI**	Thermal Power Research Institute
IGCC	Integrated Gasification Combined Cycle	**TRIG**	Transport Reactor Integrated Gasifier
KT/Y	Thousand Tons per Year	**U-GAS**	Synthesis Energy Systems Agglomerating Bed Gasifier
M^3/D	Cubic Meters per Day	**WHG**	Watergas, Entrained Bed, Dry Feed Gasifier
MCSG	Multi-Component Slurry Gasifier		
MT/Y	Million Tons per Year		
MW	Megawatts		

14. China gasification database

https://netl.doe.gov/research/coal/energy-systems/gasification/gasification-plant-databases/china-gasification-database

№	Start Year	Plant Owner	City	Province	Gasifier Type	Number of Gasifiers	Capacity (t/day)	Production	Product Type(s)
1	1974	Yunnan Army Chemical Fertilizer Plant	Kaiyuan	Yunnan	LURGI	9		250 kt/y	Ammonia
2	1983	Zhenhai Refining & Chemical Co.	Ningbo	Zhejiang	GE	3	900	1,000 tonne/d	Ammonia
3	1985	China National Petrochemical Corp./Sinopec	Urumqi	Xinjiang	GE	3	740	1,000 tonne/d	Ammonia
4	1986	China National Petrochemical Corp./Sinopec	Daqing	Heilongjiang	GE	1	75		Oxochemicals
5	1987	Shanxi Tianji Coal Chemical Industry Group Co., Ltd	Lucheng	Shanxi	LURGI	5		300 kt/y	Ammonia
6	1987	Qilu Petrochemical Industry	Zibu	Shandong	SHELL	2	246		Methanol & Oxochemicals
7	1988	CNPC Ningxia Dayuan Refining & Chemical Industry Co., Ltd.	Yinchuan	Ningxia	GE	3	1 000		Gaseous fuels
8	1991	Lanzhou Gasification Factory	Lanzhou	Gansu	LURGI	5		54×10^4 m^3/d	SNG
9	1991	Fushun Detergent Co.	Fushun	Liaoning	SHELL	1	21		Oxochemicals
10	1993	Lu Nan Chemical Industry (Group) Co./CNTIC	Tengxian	Shandong	GE	2	720	80 kt/y	Ammonia

11	1993	Harbin Gasification Plant	Harbin	Heilongjiang	LURGI	5		1.9×10^6 m^3/d SNG; 40kt/y Methanol	SNG & Methanol
12	1995	PetroChina Ningxia Petrochemical Co.	Yinchuan	Ningxia	GE	3		300 kt/y	Ammonia
13	1995	Shanghai Coking & Chemical (Shanghai Pacific)	Wujing	Shanghai	GE	4	1 800		Methanol, Town gas & Acetic acid
14	1995	Beijing No.4 Chemical	Beijing	Beijing	GE	1	110		Oxochemicals
15	1996	Shaanxi Weihe Fertilizer Co.	Xi'an	Shaanxi	GE	3	1 500	900 tonne/d	Ammonia
16	1996	Inner Mongolia Fertilizer Co.	Hohhot	Inner Mongolia	SHELL	2	672		Ammonia
17	1996	Juijiang Petrochemical Co.	Jiujiang	Jiangxi	SHELL	2	672		Ammonia
18	1997	Dalian Chemical Industrial Corp.	Dalian	Liaoning	GE	3		1,000 tonne/d	Ammonia
19	1997	Shanghai Coking & Chemical (Shanghai Pacific)	Wujing	Shanghai	GE	1	1 800		Methanol, Town gas & Acetic acid
20	1998	Lanzhou Chemical Industry Co.	Lanzhou	Gansu	SHELL	2	700		Ammonia
21	2000	Huainan General Chemical Works	Hefei	Anhui	GE	3	1 000	667 tonne/d	Ammonia
22	2000	Yima Gasification Factory, Henan Coal Group	Yima	Henan	LURGI	5		1.2×10^6 m^3/d SNG; 80kt/y Methanol	SNG & Methanol
23	2000	Zhejiang Fengdeng Chemical Industry Co., Ltd	Lanxi	Zhejiang	MCSG (NWRICI)			30 kt/y	Ammonia

24	2002	Nanjing Chemical Industry Co.,	Nanjing	Jiangsu	GE	2	385 tonne/d EUREKA® process pitch; 385 tonne/d vacuum residue oil	1,000 tonne/d	Ammonia
25	2002	Zhejiang Juhua Group Corporation	Quzhou	Zhejiang	MCSG (NWRICI)			60 kt/y	Methanol
26	2003	Jilin Chemical Industry Corp.	Jilin	Jilin	GE	2	740	1,000 tonne/d	Ammonia
27	2004	Heilongjiang Beidahuang Agriculture Co., Ltd Haolianghe Chemical Subsidiary	Yichun	Heilongjiang	GE	3	1 000		Ammonia
28	2004	Shangdong Hualu Hengsheng Group Co., Ltd	Dezhou	Shandong	MCSG (NWRICI)			300 kt/y	Ammonia
29	2005	Shandong Hualu Hengsheng Chemicals Co., Ltd.	Dezhou	Shandong	ECUST	1	750	300 kt/y	Ammonia
30	2005	Yankuang Cathay Coal Chemicals Co., Ltd.	Zaozhuang	Shandong	ECUST	2+1	1 150	240 kt/y	Methanol, IGCC
31	2005	Sinopec Jinling Pectro Chemical	Jinling	Jiangsu	GE	3	2 500	450 kt/y	Ammonia & Hydrogen
32	2005	Shaanxi Shenmu Chemical Industry Co. Ltd	Shenmu	Shaanxi	GE	3	900	200 kt/y	
33	2005	Heilongjiang Beidahuang Agriculture Co., Ltd Haolianghe Chemical Subsidiary	Yichun	Heilongjiang	GE	1	1 000		Methnol

34	2006	Tianjin Bohai Chemical Industry Co., Ltd		Tianjin	AFB (ICC/CAS)	2	200	80 kt/y	Ammonia
35	2006	Shaanxi Weihe Coal Chemical Company	Xianyang	Shaanxi	GE	1	1 500		Methanol
36	2006	Shangdong Hualu Hengsheng Group Co., Ltd	Dezhou	Shandong	MCSG (NWRICI)			200 kt/y	Methanol
37	2006	Hubei Shuanghuan Chemical Group Ltd	Yingcheng	Hubei	SHELL	1	900	200 kt/y	Ammonia
38	2006	Sinopec Anqing subsidiary	Anqing	Anhui	SHELL	1	2 200	520 kt/y	Ammonia
39	2006	Sinopec Hubei Fertilizer Subsidiary	Zhijiang	Hubei	SHELL	1	2 200	520 kt/y	Ammonia
40	2006	Yueyang sinopec & Shell Coal Gasification Co., Ltd	Yueyang	Hunan	SHELL	1	2 200	520 kt/y	Ammonia
41	2006	Shanxi Fengxi Fertilizer Industry Group Linyi Branch	Yuncheng	Shanxi	Tsinghua (1st Gen)	3	700	200 kt/y	Methanol
42	2007	Yankuang Lunan Chemical Fertilizer Plant	Tengzhou	Shandong	ECUST	1	1 150		Ammonia & Methanol
43	2007	Yancon Guohong	Zoucheng	Shandong	GE	3	3 200	500 kt/y	Methanol
44	2007	Sinopec Qilu Co.	linzi	Shandong	GE	3	1 500		Oxochemicals

45	2007	Wilson Nanjing Chemical Co., Ltd	Nanjing	Jiangsu	GE	3	1 500		Town Gas, Methanol
46	2007	Guangxi Liuzhou Chemical Industry Co., Ltd	Liuzhou	Guangxi	SHELL	1	1 100	300 kt/y	Ammonia
47	2008	Shanxi Taiyuan Chemcial Industry Group Co., Ltd	Taiyuan	Shanxi	AFB (ICC/CAS)	1	200	40 kt/y	Ammonia
48	2008	Inner Mongolia Yitai Coal Group Company Limited	Ordos	Inner Mongolia	ECUST	5	3 000	160 kt/y	CTL
49	2008	Yancon Yulin	Yulin	Shaanxi	GE	3	3 200	600 kt/y	Methanol
50	2008	Shanghai Coking & Chemical (Shanghai Pacific)	Wujing	Shanghai	GE	4	1 800	450 kt/y	Methanol / CO
51	2008	Anhui Linquan Chemical Industry Co., Ltd	Fuyang	Anhui	HTL	1	750	200 kt/y	Ammonia
52	2008	Henan Longyu Coal Chemial Industry Co., Ltd	Puyang	Henan	HTL	1	750	200 kt/y	Methanol
53	2008	Zhongyuan Dahua Co. of Henan Coal & Chemical Industry Corporation	Puyang	Henan	LURGI	3		50 kt/y	Methanol
54	2008	Anhui Huaihua Group Co., Ltd	Huaihua	Anhui	MCSG (NWRICI)			300 kt/y	Ammonia
55	2008	Inner Mongolia Yitai CTL Co., Ltd	Ordos	Inner Mongolia	MCSG (NWRICI)			160 kt/y	CTL
56	2008	Huadian Yulin Natural Gas Chemical Industry Co., Ltd	Yulin	Shaanxi	MCSG (NWRICI)			600 kt/y	Methanol

57	2008	Inner Mongolia Jiutai Energy Co., Ltd	Ordos	Inner Mongolia	MCSG (NWRICI)			900 kt/y	Methanol
58	2008	Inner Mongolia Sanwei Resources Group Co., Ltd	Ordos	Inner Mongolia	MCSG (NWRICI)			200 kt/y	Methanol
59	2008	Yunnan Yuntianhua Group Tian'an Chemical Co., Ltd	Anning	Yunnan	SHELL	1	2 700	500 kt/y	Ammonia
60	2008	Yunnan Yunwei Group Zhanhua Co., Ltd.	Qujing	Yunnan	SHELL	1	2 700	500 kt/y	Ammonia
61	2008	Inner Mongolia Shenhua Coal to Liquid and Chemical Co., Ltd	Ordos	Inner Mongolia	SHELL	2	2 200	313 t/d	Hydrogen
62	2008	Henan Kaixiang Chemical Industry Co., Ltd.	Yima	Henan	SHELL	1	1 100	200 kt/y	Methanol
63	2008	Yongcheng Coal-electricity Group	Yongcheng	Henan	SHELL	1	2 100	500 kt/y	Methanol
64	2008	Zhongyuan Dahua Co. of Henan Coal & Chemical Industry Corporation	Puyang	Henan	SHELL	1	2 100	500 kt/y	Methanol
65	2008	Shandong Haihua Coal & Chemical Co., Ltd	Zaozhuang	Shandong	U-GAS	1+1	400		Methanol
66	2009	Shanxi Tianji Coal Chemical Industry Group Co., Ltd	Lucheng	Shanxi	AFB (ICC/CAS)	2	150	300 kt/y	Methanol
67	2009	Shanxi Jincheng Anthracite Mining Group	Tianxi	Shanxi	AFB (ICC/CAS)	6	320	100 kt/y	MTG

68	2009	Jiangsu Linggu Chemical Co., Ltd	Yixing	Jiangsu	ECUST	1+1	1 800		Ammonia
69	2009	Jiangsu Sopo Group	Zhenjiang	Jiangsu	ECUST	2+1	1 500		Methanol
70	2009	Fenghuang Fertilizer Plant	Tengzhou	Shandong	ECUST	2+1	1 150	600 kt/y	Methanol
71	2009	Pucheng Clean Energy Chemical Co., Ltd	Weinan	Shaanxi	GE	3	2 000		Methanol
72	2009	Shanxi Lu'an Group	Changzhi	Shanxi	LURGI	6		16 kt/y	CTL
73	2009	Shenhua Ningxia Coal Industry Group	Yinchuan	Ningxia	LURGI			540 kt/y	Propylene
74	2009	Inner Mongolia Nailun Group Inc.	Hohhot	Inner Mongolia	MCSG (NWRICI)			300 kt/y	Ammonia
75	2009	Gansu Huating Zhongxu Coal Chemical Industrial Co., Ltd	Lanzhou	Gansu	MCSG (NWRICI)			600 kt/y	Methanol
76	2009	Guizhou Xinsheng Coal Chemical Industrial Co., Ltd	Liupanshui	Guizhou	MCSG (NWRICI)			300 kt/y	Methanol
77	2009	Hefei Sifang Group Co., Ltd	Hefei	Anhui	MCSG (NWRICI)			200 kt/y	Methanol
78	2009	Shanxi Hualu Coal Chemcial Industry Co., Ltd	Yizhou	Shanxi	MCSG (NWRICI)			200 kt/y	Methanol
79	2009	Dalian Dahua Group Co., Ltd	Dalian	Liaoning	SHELL	1	1 100	300 kt/y	Methanol
80	2010	Shenhua Ningxia Coal Group	Yinchuan	Ningxia	ECUST	2+1	2 000	750 kt/y	Methanol

81	2010	Ningbo Wanhua Co., Ltd	Ningbo	Zhejiang	ECUST	2+1	1 200		Methanol, Ammonia & H_2
82	2010	Shandong Dongying Lihuayi Group	Dongying	Shandong	GE	2	600		Butanol & Octanol
83	2010	China Shenhua Coal to liquid Chemical Co., Ltd	Baotou	Inner Monogolia	GE	8	1 500		Methanol
84	2010	Ordos Menghua Energy Co., Ltd	Ordos	Inner Mongolia	MCSG (NWRICI)			200 kt/y	Ammonia
85	2010	Shandong ACID Chemcials Co., Ltd	Tai'an	Shandong	MCSG (NWRICI)			300 kt/y	Ammonia
86	2010	Xinjiang Tianfu Thermoelectric Co., Ltd	Shihezi	Xinjiang	MCSG (NWRICI)			300 kt/y	Ammonia
87	2010	Chongqing Wansheng Coal Chemical Industrial Co., Ltd	Chongqing	Chongqing	MCSG (NWRICI)			300 kt/y	Methanol
88	2010	Guizhou Panjiang Coal and Electricity Group Co., Ltd	Liupanshui	Guizhou	MCSG (NWRICI)			600 kt/y	Methanol
89	2010	Inner Mongolia Mengda New Energy Chemical Industry Base Development Co., Ltd	Ordos	Inner Mongolia	MCSG (NWRICI)			600 kt/y	Methanol
90	2010	Ningxia Baota Petrochemcial Group	Yinchuan	Ningxia	MCSG (NWRICI)			600 kt/y	Methanol
91	2010	Shaanxi Yanchang Petroleum Group Co., Ltd	Xi'an	Shaanxi	MCSG (NWRICI)			600kt/y	Methanol

92	2010	Guizhou Tianfu Chemical Industry Corp.	Zhi'na	Guizhou	SHELL	1	2 000	300 kt/y	Ammonia
93	2010	Tianjin Bohai Chemical Industry Co., Ltd.	Linhai	Tianjin	SHELL	2	2 400	300 kt/y Ammonia; 500 kt/y Methanol	Ammonia & Methanol
94	2011	ENN	Ordos	Inner Mongolia	GE	3	3 200		Methanol
95	2011	Anhui Linquan Chemical Industry Co., Ltd	Fuyang	Anhui	HTL	1	750	200 kt/y	Ammonia
96	2011	Henan Zhongxin Chemical Industry Co., Ltd	Xinxiang	Henan	HTL	2	750	300 kt/y	Ammonia
97	2011	Shandong Luxi Chemical Group Co., Ltd	Liaocheng	Shandong	HTL	2	750	300 kt/y	Ammonia
98	2011	Xinjiang Guanghui New Energy Co., Ltd	Guanghui	Xinjiang	LURGI	14		120 kt/y Methanol; 80kt/y DME	DME & Methanol
99	2011	Datang Shaanxi Fugu Energy Chemical Industry Co., Ltd	Yulin	Shaanxi	MCSG (NWRICI)			600 kt/y	Methanol
100	2011	Inner Mongolia Yihua Group Co., Ltd	Ordos	Inner Mongolia	MCSG (NWRICI)			600 kt/y	Methanol
101	2011	Datang International Power Generation Co., Ltd.	Duolun	Inner Mongolia	SHELL	3	2 800	460 kt/y	Polypropylene
102	2011	Yancon Energy Chemical Co., Ltd	Kaiyang	Guizhou	SIEMENS	2	1 500	500 kt/y	Ammonia

103	2011	Shenhua Ningxia Coal Industry Group	Yinchuan	Ningxia	SIEMENS	5	2 000	Polypropylene 520 kt/y, gasoline 184,8 kt/y, liquid fuel 41,2 kt/y	Polypropylene, Gasoline & LPG
104	2012	Yunnan Wenshan Aluminum Co., Ltd	Wenshan	Yunnan	AFB (ICC/CAS)	3	456	800 kt/y	Aluminum
105	2012	Shanxi Yangmei Fengxi Fertilizer Industry (Group) Co., Ltd	Linyi	Shanxi	AFB (ICC/CAS)	1	150	150 kt/y	Ammonia
106	2012	Yankuang Xinjiang Coal Chemicals Co., Ltd	Urumqi	Xinjiang	ECUST	2+1	1 500		Ammonia
107	2012	Anhui Huayi Group Company	Wuhu	Anhui	ECUST	2+1	1 500	600 kt/y	Methanol
108	2012	Shaanxi Weihe Coal Chemical Company	Weinan	Shaanxi	GE	1	1 600		Acetic Acid
109	2012	Sinopec Shengli Oilfield	Dongying	Shandong	GE	2	1 500		Butanol & Octanol
110	2012	Shaanxi Yulin Shenmu Chemical Industry Co. Ltd	Yulin	Shaanxi	GE	3	1 200	360 kt/y	Methanol
111	2012	Guizhou Chitianhua Group Co. Ltd	Tongzi	Guizhou	GE	3	3 200	300 kt/y Methanol & 300 kt/y Ammonia	Methanol & Ammonia
112	2012	Huaneng Tianjin Coal Gasification Power Generation Co., Ltd		Tianjin	TPRI		2 000	250 MW	IGCC
113	2012	Inner Mongolia Shilin Chemical Industry Co., Ltd	Ordos	Inner Mongolia	TPRI	1	1 000	300 kt/y	Methanol

114	2012	Inner Mongolia Datang Hulunbuir Fertilizer Co., Ltd	Hulunbuir	Inner Mongolia	Tsinghua (1st Gen)		700	180 kt/y Ammonia; 300 kt/y Urea	Ammonia & Urea
115	2012	Ordos Jinchengtai Chemical Industry Co., Ltd	Ordos	Inner Mongolia	Tsinghua (1st Gen)		1 100	300 kt/y	Methanol
116	2012	Shanxi Fengxi Fertilizer Industry Group Linyi Branch	Yuncheng	Shanxi	Tsinghua (2nd Gen)		700	300 kt/y	Methanol
117	2012	Henan Yima Coal Industry Group Co.	Yima	Henan	U-GAS	2+1	2 400		Methanol
118	2015	Shanxi Lanhua Coal Chemical Co., Ltd	Jincheng	Shanxi	SIEMENS	2	2 000	300 kt/y Ammonia & 520 kt/y Urea	Ammonia & Urea
119	Construction	China Pingmei Shenma Group	Pingdingshan	Henan	AFB (ICC/CAS)	2	250	160 kt/y	Ammonia
120	Construction	Inner Mongolia Yitai CTO Co., Ltd	Yitai	Inner Mongolia	AFB (ICC/CAS)		150	160 kt/y	CTO
121	Construction	Shanxi Luan Mining Group Company	Changzhi	Shanxi	AFB (ICC/CAS)		150	160 kt	Gasoline
122	Construction	Shaanxi Yulin Coal Chemical Industry Co., Ltd	Yulin	Shaanxi	AFB (ICC/CAS)	1		200 kt/y	Methanol
123	Construction	Shanxi Xiangyuan Qiyi Coal Mining	Changzhi	Shanxi	AFB (ICC/CAS)	2	150	300 kt/y	Methanol
124	Construction	Inner Mongolia Huomei Shuangxing Gasification Co., Ltd	Huolin Gol	Inner Mongolia	AFB (ICC/CAS)			60 km^3/h	SNG

125	Construction	China National Coal Group Corp. Ordos Energy Chemical & Industry Co., Ltd	Ordos	Inner Mongolia	BGL	7	1 251	100 kt/y Ammonia; 175 kt/y Urea	Ammonia & Urea
126	Construction	Henan Jinmei Tianqing Coal Chemical Co., Ltd	Qinyang	Henan	BGL	8	800	18 kt/y Ammonia; 30kt/y Urea	Ammonia & Urea
127	Construction	Henan Yuntianhua Group	Hulunbuir	Inner Mongolia	BGL	3	1 250	50 kt/y Ammonia; 80kt/y Urea	Ammonia & Urea
128	Construction	China YiTuo Group of Luoyang	Luoyang	Henan	BGL	2	650	43,000 NM^3/h	Fuel Gas
129	Construction	Anyang Yingde Gasification Co., Ltd	Anyang	Henan	ECUST	1+1	2 200		Ammonia
130	Construction	Guizhou Kaiyang Chemical Co., Ltd	Guiyang	Guizhou	ECUST	2	1 100	500 kt/y	Ammonia
131	Construction	Henan XLX Fertilizer Co., Ltd	Xinxiang	Henan	ECUST	2+1	1 200		Ammonia
132	Construction	Inner Mongolia Wuyuan Jinniu Coal Chemical Co., Ltd	Wuyuan	Inner Mongolia	ECUST	1+1	1 200		Ammonia
133	Construction	Shandong Haili Chemical Industry Co., Ltd	Zibo	Shandong	ECUST	1+1	2 000		Ammonia
134	Construction	Xinjiang XLX Fertilizer Co., Ltd	Urumqi	Xinjiang	ECUST	2	1 500		Ammonia
135	Construction	Zhongyan Kunshan Co., Ltd	Kunshan	Jiangsu	ECUST	1+1	1 800		Ammonia
136	Construction	Yantai Wanhua Group	Yantai	Shandong	ECUST	2+1	1 500		Ammonia & Methanol

137	Construction	Inner Mongolia Yitai CTL Co., Ltd	Yili	Xinjiang	ECUST	4+1	3 000	540 kt/y	CTL
138	Construction	Shaanxi Future Energy Chemical Industry Co., Ltd	Yulin	Shaanxi	ECUST	6+2	2 200		CTL
139	Construction	China Huadian Power Group	Hangzhou	Zhejiang	ECUST	1	2 000	20 0MW IGCC	Electricity
140	Construction	Ningbo Zhongjin Chemical Co., Ltd	Ningbo	Zhejiang	ECUST	1+1	750		Fuel Gas
141	Construction	Inner Mongolia Jingneng Coal Chemicals	Ordos	Inner Mongolia	ECUST	2+0	2 000		Hydrogen
142	Construction	China Oceanwide Baotou Coal Chemical Co., Ltd.	Baotou	Inner Mongolia	ECUST	2+1	1 500		Methanol
143	Construction	Ordos Haohua Clean Coal Co., Ltd	Ordos	Inner Mongolia	ECUST	1+1	2 000		Methanol
144	Construction	Qinghai Salt Lake Industry Co., Ltd	Yanhu	Qinghai	ECUST	2+1	2 200		Methanol
145	Construction	Shanghai Coking & Chemical Corporation	Shanghai	Shanghai	ECUST	1+1	2 000		Methanol
146	Construction	Yankuang Inner Mongolia Coal Chemicals Co., Ltd	Ordos	Inner Mongolia	ECUST	2+1	3 000		Methanol
147	Construction	Shandong Shengda Ningdong Chemicals Co., Ltd,	Tai'an	Shandong	ECUST	1+1	2 000	500 kt/y	Methanol
148	Construction	Shandong Jiutai Co., Ltd	Linyi	Shandong	ECUST	4+2	2 000	1200 kt/y DME	Methanol & DME
149	Construction	Anhui Haoyuan Chemical Industry (Group) Co., Ltd	Fuyang	Anhui	HTL	2	750	300 kt/y	Ammonia

150	Construction	Henan Haohua-Junhua Group Co., Ltd	Zhumadian	Henan	HTL	2	1 500	600 kt/y	Ammonia
151	Construction	Henan Jinkai Investment Holding Group	Kaifeng	Henan	HTL	2	1 500	600 kt/y	Ammonia
152	Construction	Henan Jinkai Investment Holding Group	Kaifeng	Henan	HTL	2	1 500	600 kt/y	Ammonia
153	Construction	Jinmei Zhongneng Chemical Industry Co., Ltd	Manas	Xinjiang	HTL	1	750	200 kt/y	Ammonia
154	Construction	Shandong Luneng Baoqing Coal-Electricity Chemistry Development Co., Ltd	Baoqing	Heilongjiang	HTL	2	750	300 kt/y	Ammonia
155	Construction	Shandong Ruixing Chemical Group Co., Ltd	Tai'an	Shandong	HTL	1	1 500	300 kt/y	Ammonia
156	Construction	Sichuan Lutianhua Co., Ltd	Chengdu	Sichuan	HTL	2	750	450 kt/y	Ammonia
157	Construction	Inner Mongolia Chengfeng Petrochemical Co., Ltd	Ordos	Inner Mongolia	HTL	2	750	2×10^8 m^3/y	CH_4
158	Construction	Heilongjiang Longmay Mining Holding Group Co., Ltd	Harbin	Heilongjiang	HTL	2	750	300 kt/y	Methanol
159	Construction	Datang Energy Chemical Company Ltd.	Hexigten	Inner Mongolia	LURGI	48		4×10^9 m^3/y SNG	SNG

160	Construction	Henan Hebi Coal & Electricity Co., Ltd	Hebi	Henan	SHELL	1	2 700	600 kt/y	Methanol
161	Construction	Shanxi Datong Coal Mine Group	Datong	Shanxi	SHELL	1	2 700	600 kt/y	Methanol
162	Construction	Yunnan Yuntianhua Group	Shuifu	Yunnan	SHELL	1	1 100	300 kt/y	Methanol
163	Construction	China Power Investment Corp.	Yili	Xinjiang	SIEMENS	8	2 000	6 billion Nm^3/y SNG	SNG
164	Construction	Huaneng Hulunbuir Energy Development Co., Ltd	Hulunbuir	Inner Mongolia	TPRI		2 800	600 kt/y	Methanol
165	Construction	Shanxi Hualu Coal Chemcial Industry Co., Ltd	Yizhou	Shanxi	TPRI		1 000	200 kt/y	Methanol
166	Construction	Shanxi Xinsheng Coal Chemical Industry Co., Ltd	Yuncheng	Shanxi	TPRI		1 000	300 kt/y	Methanol
167	Construction	Huaneng Ningxia Energy Co., Ltd	Taiyangshan	Ningxia	TPRI		2 400	1,200 kt/y Methanol; 400 kt/y Olefin	Methanol & Olefin
168	Construction	Huaneng Xinjiang Huaidong Energy Development Co., Ltd	Huaidong	Xinjiang	TPRI	8	3 300	4×10^9 m^3/y	SNG
169	Construction	Dongguan Tianming Electric Power Co., Ltd	Dongguan	Guangdong	TRIG (KBR)	1		120 MW (Phase I) + 800 MW (Phase II) IGCC	Electricity

170	Construction	Shanxi Coking Group Co., Ltd	Hongdong	Shanxi	Tsinghua (1st Gen)		700	200 kt/y	Acetic Acid
171	Construction	Jiangsu Yongpeng Chemical Industry Technic Co., Ltd	Xuzhou	Jiangsu	Tsinghua (1st Gen)			26,000 NM^3/h	Hydrogen
172	Construction	Shanghai Huisheng Ordos Guotai Chemical Industry Co., Ltd	Ordos	Inner Mongolia	Tsinghua (1st Gen)		1 800	400 kt/y	Methanol
173	Construction	Jiangsu Huachang Chemical Industry Co., Ltd	Zhangjiagang	Jiangsu	Tsinghua (2nd Gen)	2	2 000	330 kt/y Ammonia; 2×10^8 Nm^3/y Hydrogen	Ammonia; Hydrogen
174	Construction	Jiangsu Debang Chemical Industry (Group) Co., Ltd	Lianyungang	Jiangsu	Tsinghua (2nd Gen)	2			Ammonia; Sodium; Urea
175	Construction	Shandong Changyi Yingde Gas Co., Ltd	Changyi	Shandong	Tsinghua (2nd Gen)	2			Butanol & Octanol
176	Construction	Karamay Yingde Gas Co., Ltd	Karamay	Xinjiang	Tsinghua (2nd Gen)	3		60,000 NM^3/h	Gasoline & Hydrogen
177	Construction	Shijiazhuang Yingding Gas Co., Ltd	Shijiazhuang	Hebei	Tsinghua (2nd Gen)	3			Gasoline & Hydrogen
178	Construction	Henan		Henan	WHG		1 300		Various
179	Contract not implemented	Shenhua Ningxia Coal Industry Group	Yinchuan	Ningxia	SHELL	4	2 000	3500 kt/y	CTL
180	Contract not implemented	Henan Longyu Coal Chemial Industry Co., Ltd	Puyang	Henan	SHELL	1	2 100	500 kt/y	Methanol
181	Contract not implemented	Anhui Huainan Chemical Group Co., Ltd	Huainan	Anhui	SIEMENS			300 kt	Ammonia

182	Contract not implemented	Jiangsu Linggu Chemical Co., Ltd	Linggu	Jiangsu	SIEMENS			300 kt	Ammonia
183	Design	Inner Mongolia Berun Group	Ordos	Inner Mongolia	TRIG (KBR)	1		3.5k Nm^3/hr syngas as feedstock to produce 100kt/y ethylene glycol	Ethylene Glycol
184	Discontinued	Hebei Shijiazhuang Jinshi Chemical Fertilizer Co., Ltd	Shijiazhuang	Hebei	AFB (ICC/CAS)		324	50 kt/y	Ammonia
185	Discontinued	Shaanxi Chenggu Fertilizer Co., Ltd	Hanzhong	Shaanxi	AFB (ICC/CAS)	1	100	20 kt/y	Ammonia
186	ENG Completed	Shenhua Ningxia Coal Industry Group	Yinchuan	Ningxia	SIEMENS	24	2 000	4 million tonne/y Diesel Naphtha	CTL
187	License	Shandong Jincheng Chemical Industry Technic Co., Ltd	Zibo	Shandong	Tsinghua (2nd Gen)		1 000	60,000Nm^3/h	CO, Hydrogen