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AT THE SHOW

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A worker at a Chinese drilling operation
Photo: REUTERS/SCANPIX

China looks to exploit its oil and gas reserves

Chinese national oil companies have reported huge oil and gas discoveries year after year, but development challenges mean the country will likely continue to rely on imports to meet growing demand. Pages 2&3

近年来，中国国家石油公司频频报道可观的油气发现，但复杂的地质构造和高昂的开发成本使得这些发现商业化面临不确定因素，这意味着今后中国有可能继续依赖进口来满足不断增长的油气需求。

P2&3

EXPLORATION

China racks up the reserves but recoverability remains in question

Developing massive oil and gas discoveries is more challenging than finding them, and the country will likely continue to rely on imports to meet growing demand

XU YIHE
Singapore

CHINESE national oil companies have reported huge oil and gas discoveries year after year, but little has been commercialised.

Led by China National Petroleum Corporation (CNPC), the companies are never short of reserves figures that impress government officials but make little sense to technocrats.

CNPC consistently reports multiple discoveries, each with a minimum reserves size of 1 billion tonnes (7.35 billion barrels) of what it calls "geological" oil reserves.

The other two state players, Sinopec and China National Offshore Oil Corporation (CNOOC), make similar claims.

The trio could be highlighting reserves that may never be developed. In practice, the theoretical amount of oil in the reservoir, the oil in place, carries little meaning.

What matters to the industry are the reserves that can be physically recovered under current market conditions, factoring in technology, oil prices and lifting costs.

The Chinese state players cite complex geology featuring low permeability, low porosity and low productivity for the slow pace of development.

Technical challenges and high production costs have indeed hampered oil and gas development.

CNPC's exploration and gas division vice president Li Guoxin says conventional technology is unable to tap complex reservoirs, typically those involving shale gas.

Li says about 80% of new shale gas discoveries are trapped in reservoirs beyond 3500 metres, which poses serious development challenges.

Maintaining well integrity while drilling is another challenge in the shale reservoirs, which helps explain the exit of international oil and gas majors from the sector after poor results.

Nevertheless, the optimistic announcements continue.

In 2007, then-prime minister Wen Jiabao was elated by the news that CNPC had discovered 1.18 billion tonnes (8.6 billion barrels) of oil equivalent at the Jidong-Nanpu oilfield in northern China.

A find of that size would see China pass Libya to take the ninth spot in the world's oil reserve rankings. "This is the most exciting discovery in Chinese oil exploration of the last 40 years," Wen said.

According to a preliminary plan, CNPC aimed to produce 10 million tonnes per annum of oil from the Nanpu play by 2012, a volume forecast to rise to 25 million tpa — figures much inflated compared with the standards Western companies use to estimate recoverable reserves.

As of today, the Nanpu discovery is not listed by CNPC as a producing asset.

In 2007, just ahead of the country's annual parliament congress in March, when the government appoints new ministers, CNPC's then-president Jiang Jiemin announced the Longgang gas discovery in the Sichuan basin, with potential to hold 400 billion cubic metres of gas. Jiang said CNPC had embarked on a development scheme that aimed to establish 2 Bcm of gas capacity by 2008.

There have been no further announcements about the Longgang discovery.

Last year, CNPC announced at least three major finds.

The company said it plans to build a production capacity of 5 million tpa at an Ordos basin discovery that holds an estimated 1 billion tonnes of shale oil reserves.

In the Tarim basin, CNPC discovered another 1 billion tonnes of oil reserves in reservoirs 8000 metres deep in an area covering 10,000 square kilometres — its biggest discovery in 10 years.

The company hopes to establish 5 million tpa of production capac-

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Reserves push: a CNPC facility in China
Photo: REUTERS/SCANPIX

ity by 2025. Also last year, CNPC made a 1.268-billion-tonne discovery at the Gulong prospect at the depleting Daqing oilfield.

Sinopec, meanwhile, announced it had added 167 million tonnes of proven oil reserves and 268.1 Bcm of gas reserves.

In mid-January, it revealed two discoveries with multi-billion cubic metres of gas reserves, but acknowledged the challenges to commercial development.

In Hubei province, it discovered 400 Bcm of shale gas reserves in reservoirs deeper than 4000 metres after just two exploration wells.

At the Shengli oilfield, Sinopec announced 4 billion tonnes of oil in place, with 468 million tonnes considered “geological reserves” – theoretical reserves without appraisal drilling.

It has also discovered 1.85 billion tonnes of shale oil reserves at three prospects at Shengli. Offshore operator CNOOC Ltd — the listed subsidiary of China National Offshore Oil Corporation — made four discoveries in 2021, the largest being Bozhong 13-2 in Bohai Bay, where around 346 metres of oil pay zones were encountered.

The successful probe flowed about 1980 barrels per day of oil and 5.25 million cubic feet per day of gas during testing.

The company has targeted production of 1.2 million tonnes of oil from Bozhong 13-2.

Also in Bohai Bay, CNOOC Ltd billed Kenli 10-2 as a “large-sized” discovery with recoverable oil resources of 100 million tonnes.

In the South China Sea, the company has made what it called a “significant oil and gas find” at Huizhou 26-6 in the Pearl River Mouth basin.

Huizhou 26-6 holds 50 million cubic metres of hydrocarbon reserves, as confirmed by the Ministry of Natural Resources. CNOOC Ltd is also going onshore with the Linxing gas prospect in Shanxi province, where reserves are now pegged at 101 billion cubic metres.

Despite such discoveries, China is still struggling to keep production from falling.

Oil output in 2021 increased by just 2.4% year on year, to 198.98 million tonnes, and the world’s second-largest economy still imported 512.98 million tonnes (10.26 million bpd) of oil last year.

Such modest incremental domestic production is far from enough to allay government concerns about energy security.

When visiting Sinopec’s Shengli oilfield last October, Chinese President Xi Jinping said: “Oil energy construction is very significant to our country. As a major manufacturing power, China has to secure its energy supply in its own hand.

中国油气发现规模可观，但面临开采挑战

中国国有石油公司总是年复一年地公布大型油气发现，但实际商业化的项目却寥寥无几。

以中国石油天然气集团有限公司为代表的中国国有石油公司从不缺乏令人印象深刻的储量数据，但对技术专家来说则意义不大。

中国石油一如既往地报告多处发现，每个发现的最低储量为 10 亿吨（73.5 亿桶）所谓的“石油地质储量”。对于中国石化和中国海洋石油，说辞也相差无几。

从实际经验来看，油藏中的理论储量，即预期石油资源量，几乎毫无意义。对行业而言，真正有意义的是在当前市场条件下可实际采收的储量，考虑到技术、油价和驱油成本。

开发缓慢的原因往往归咎于地质条件复杂（包括低渗透、低孔隙度和低产能）。油气开发确实受制于技术难题和高昂的生产成本。

中国石油勘探与天然气事业部副总裁李国欣表示，常规技术难以开采复杂的储层，尤其是页岩气储层。李国欣说，大约 80% 的新页岩气发现在3500 米以上的储层中，使得开发颇为棘手。

页岩气储层面临的另一项挑战是，如何在钻井过程中保持井的完整性，这也是国际油气巨头在发现勘探结果不佳后选择退出的原因。

尽管如此，中国油气公司依旧不断释放有利消息。在塔里木盆地，中国石油在占地1万平方公里、深8000米的油藏中又发现了10亿吨石油储量，是10年来的最大发现。中石油希望到2025年建立500万吨/年的产能。

同样在去年，中国石油在大庆油田的古龙勘探区发现一处 12.68 亿吨发现。

与此同时，中国石化宣布新增探明石油储量1.67亿吨，天然气储量2681 亿立方米。

1月中旬，它还公布了两个具有数十亿立方米天然气储量的发现，但坦承商业开发面临着诸多挑战。

在湖北省，中国石化仅通过两口探井，就在深4000 米以上的储层中发现了 4000亿立方米的页岩气储量。

在胜利油田，中国石化宣布预期石油资源量达到40亿吨，其中4.68亿吨是“石油地质储量”——未经评估钻探的理论储量。

它还在胜利油田的三个勘探区发现了18.5亿吨页岩油储量。

2021年，中国海洋石油集团有限公司旗下上市公司中国海洋石油有限公司公布了四项发现，其中最大的是渤海湾渤中13–2油气田，共钻遇约346米厚的油层。

这项探勘非常成功，测试期间而每天生产约1980 桶石油和 525 万立方英尺天然气。中国海油计划在渤中13–2油气田产量达到120万吨石油。

同样在渤海湾，中国海油将垦利10–2列为“大型”发现，可采石油资源量达1亿吨。

在南中国海，该公司声称在珠江口盆地的惠州26–6油气田获得了“重大油气发现”。经自然资源部确认，惠州26–6油气田拥有5000万方油当量。

中国海油还在山西省临兴天然气勘探区进行陆上勘探，目前储量为 1010 亿立方米。

尽管拥有这些发现，中国依旧艰难地维持产量不下降。

2021年中国的石油产量同比仅增长2.4%，达到1.9898 亿吨，而去年仍进口 5.1298 亿吨（合1026万桶/日）石油。

鉴于国内生产增量如此缓慢，中国政府对能源安全的担忧远远难以纾困。

去年10月，中国国家主席习近平在视察中石化胜利油田时说道：“石油能源建设对我们国家意义重大，中国作为制造业大国，要发展实体经济，能源的饭碗必须端在自己手里。”

FABRICATION

Activity: Semi-submersible drilling rig Deepsea Yantai is slated to work for Neptune for a three-well campaign
Photo: CIMC RAFFLES

China putting its idle rigs back to work

Rig manager SinoOcean busy chartering stacked units for domestic and overseas drilling

XU YIHE
Singapore

DRILLING rig inventories at Chinese yards have dropped by 12 units with major stock draws from Cosco Shipping Heavy Industries and CIMC Raffles, though some of the rigs have been retrofitted for operation as offshore wind vessels.

Most of the stacked rigs are now managed by SinoOcean Offshore Engineering Assets Management, a state-owned entity set up by the government three years ago to consolidate China's offshore engineering industry, which chartered the stacked rigs on behalf of yards.

There are 33 rigs, mostly jack-ups, that remain stacked at Chinese yards, down from 45 at the start of 2020.

Three yards — Dalian Shipbuilding Industry Offshore Company, Shanhaiguan New Shipbuilding Industry and Shanghai Shipyard — account for 22 units of the total stacked rigs. Shanghai Shipyard, now part of Shanghai Waigaoqiao Shipbuilding, has set up a special-purpose company to complete construction of four currently stacked Tiger drillships ordered by Singapore's Opus Offshore in 2011 but abandoned in the rig market downturn.

Close to a dozen rigs, including eight ordered by Seadrill, continue to lie idle at DSIC Offshore in Dalian city.

Late last year, a Chinese court endorsed a scheme to restructure DSIC Offshore that involves converting 648.48 million yuan ($101 million) the company owed creditors into equities now owned by the creditors in a new company.

Shanhaiguan, which is now owned by DSIC Offshore's parent Dalian Shipbuilding Industry Corporation, still stacks four jack-up rigs ordered and later abandoned by Singapore's Falcon Energy.

Falcon's associate company FTS Derricks had entered into contracts with Shanhaiguan in 2013 to build four jack-ups.

Some of the rigs chartered earlier have won contract extensions. Neptune Energy has decided to retain the CIMC Raffles-built semi-submersible Deepsea Yantai to drill more wells in the North Sea, with potential to exercise options to keep the rig in the area beyond 2022.

The Deepsea Yantai has been under contract with Neptune since June 2019 on a 16-well campaign, which carried options for five additional wells.

At least a half-dozen offshore units abandoned at Chinese yards, including jack-up rigs and accommodation barges, have been retooled for operation as offshore wind vessels.

SinoOcean signed a bareboat agreement to modify and charter two offshore drilling rigs it currently manages to PowerChina Guizhou Engineering, a power facility engineering, procurement and construction contractor owned by utility China Huadian.

Another jack-up to be reconfigured is a JU2000E rig built by Shanghai Waigaoqiao Shipbuilding.

As the drilling market declined, orders for offshore wind farm installation vessels started to flood in.

Chinese yards are now among the world's busiest in building offshore wind installation vessels, with up to 20 such vessels under construction, including 12 for domestic use and the remainder ordered by foreign offshore wind players.

The latest order was awarded by Netherlands-based ThreeX BV, which signed a letter of award with Chinese yard CIMC Raffles for building a heavy-lift vessel for offshore wind farm installation work.

中国努力将闲置钻井平台推向市场

中国船企的钻井平台库存数下降了 12 座，库存主要来自中远海运重工和中集来福士，尽管其中部分钻井平台改装成了海上风电船舶。

目前，中国闲置钻井平台大多由国海海工资产管理有限公司管理。国海海工是中国政府三年前成立的国有企业，旨在整合中国海洋工程装备，并代表船厂租赁闲置钻井平台。

目前，中国船厂仍有 33 座钻井平台闲置，主要是自升式钻井平台，低于 2020 年初的 45 座。

近十二座钻井平台，包括 Seadrill 订购的 8 座，继续闲置在位于大连市的大船海工。海关造船目前隶属于大连海工母公司大船集团，依旧闲置着四座自升式钻井平台，原本由新加坡Falcon Energy订购，但惨遭弃单。

早些时候，部分钻井平台租赁赢得了合同延期。Neptune Energy已决定保留中集来福士建造的半潜式钻机Deepsea Yantai，以在北海钻探更多井，并有可能行使选择权，将钻井平台租期延期至 2022 年以后。

自2019年6月起'"Deepsea Yantai"号与Neptune签订了一项16口井的合同，其中包含另外 5 口井的选择权。

至少有六座遭弃单留在中国船厂的海上装置（包括自升式钻井平台和住宿驳船），已被改装成海上风电船舶。

国海海工签署了一项光船协议，将目前管理的两台海上钻井平台改造和租用给中国电建集团贵州工程有限公司，后者是隶属于中国华电旗下的电力设施设计、采购和施工（EPC）承包商。另一座需要改造的自升式钻井平台是上海外高桥造船承建的"JU2000E"号钻井平台。

随着钻井市场行情不景气，海上风电场安装船的订单开始涌入。

cippe 振威石油展

Friday 29 July 2022

The editorial content of this section, pages 5 to 8, is the sole responsibility of cippe's organisers

cippe Gold Innovation Award goes to Safety Evaluation of In-service Oil Derrick and Offshore Structural Equipment

On 28 July, the 22nd China International Petroleum and Petrochemical Technology and Equipment Exhibition (cippe2022) opened in Shenzhen, China.

The cippe organizing committee specially invited academicians of the Chinese Academy of Sciences, the Chinese Academy of engineering and the most influential senior experts in the industry to form a review committee.

From more than 10,000 exhibits of 1,000 exhibitors, the "Key Technologies for Safety Evaluation of In-service Oil Derrick and Offshore Structural Equipment" won the "cippe Gold Innovation Award".

"Key Technologies for Safety Evaluation of In-service Oil Derrick and Offshore Structural Equipment" was jointly completed by Northeast Petroleum University and its SANYA Offshore Oil & Gas Research Institute, and was managed by PetroChina in July 2022.

The Ministry organized five academicians and eight experts to appraise it at the international advanced level.

Due to the frequent disassembly and transportation of onshore derricks, the perennial high salt marine corrosive environment of offshore derricks and structural equipment, the dynamic load of drilling operations, overload, hurricanes and waves in the marine environment and other factors, derricks and offshore structural equipment are prone to deformation, fatigue, cracks, corrosion and other damages during service.

This results in a significant reduction in the bearing capacity and durability of derricks and offshore structural equipment, which seriously affects the safety of onshore and offshore oil and gas drilling development and production.

"Key Technologies for Safety Evaluation of In-service Oil Derrick and Offshore Structural Equipment", through the bearing test of physical prototype/indoor model/digital model, macro (deformation) and micro (crack) damage detection, digital twin model simulation test, the scientific and objective evaluation of the safe bearing of derrick and offshore structural equipment is given according to the theoretical criterion of strength stability.

Repair suggestions for various damages to derricks and offshore structural equipment are put forward at the same time.

This technology has been proved to be scientific and feasible by a large number of practical verifications and promotions.

This technology innovates the physical model and test device, damage identification and detection technology, structural performance testing technology, digital twinning and safety evaluation technology, and provides a guarantee for the safe production of land and marine oil and gas resources exploration and development.

This technology has accumulatively produced six patents, formulated and revised three standard specifications, and has been the subject of 30 published papers.

From 2016 to 2021, Northeast Petroleum University and SANYA Offshore Oil & Gas Research Institute inspected 446 derricks of various types, among which, 330 derricks in service have been put forward with opinions on degradation, and five derricks in service have been put forward with opinions on scrapping and written off in time, which eliminated potential safety hazards.

In terms of other offshore detection, the project team has completed the inspection of one offshore drilling rig substructure, 23 offshore cranes, three offshore platforms and two land terminal pipelines of CNOOC, which provides a reliable guarantee for the safe production of onshore and offshore oil and gas resources exploration and development, and provides a theoretical basis and technical services for the safe production of oilfields.

现役石油井架及海洋结构装备安全评价关键技术荣获cippe2022展品创新金奖

第二十二届中国国际石油石化技术装备展览会如期在深圳举办，组委会特邀中国科学院院士、中国工程院院士及行业内最具影响力的资深专家组成评审委员会，从1000多家参展商近万种展品中评选出“现役石油井架及海洋结构装备安全评价关键技术”为“cippe展品创新金奖”。

“现役石油井架及海洋结构装备安全评价关键技术”由东北石油大学、东北石油大学三亚海洋油气研究院共同完成，经由中国石油科技管理部组织5位院士、8名专家评审鉴定为国际先进水平。

由于陆上井架经常拆装运输、海洋井架与结构装备常年处于高盐海洋腐蚀环境，钻井作业动载、超载作用、海洋环境飓风巨浪等因素的影响，井架及海洋结构装备在服役期间易产生变形、疲劳、裂纹和锈蚀等各种损伤，导致井架及海洋结构装备承载能力及耐久性大幅降低，严重影响着陆海油气钻探开发生产的安全。“现役石油井架及海洋结构装备安全评价关键技术”，通过实物原型/室内模型/数字模型的试验研究、宏观（变形）与微观（裂纹）损伤检测、数字孪生模型仿真试验，并按照强度稳定理论判据给出了井架及海洋结构装备安全承载科学客观评价，同时对井架及海洋结构装备的各种损伤提出了修复建议。此技术经大量实践验证及推广应用，证明是科学可行的。该项技术创新了实物模型与试验装置、损伤识别检测技术、结构性能测试技术、数字孪生与安全评价技术，为确保陆地与海洋油气资源勘探开发安全生产提供了保障。

此项技术累计授权专利6件，制修定标准规范3项，发表论文30篇。

自2016~2021年来东北石油大学、东北石油大学三亚海洋油气研究院项目组共检测各型井架446部，其中对330部在役的井架提出了降级使用意见、对5部在役的井架提出报废意见，并及时核销，消除了安全隐患。项目组在海上其他检测方面，完成了中海油1部海上钻机底座检测、23部海上吊机检测、3个海洋平台结构监测，2个陆地终端管线监测。为确保陆上与海洋油气资源勘探开发安全生产提供了可靠保障，为各油田的安全生产提供理论依据与技术服务。

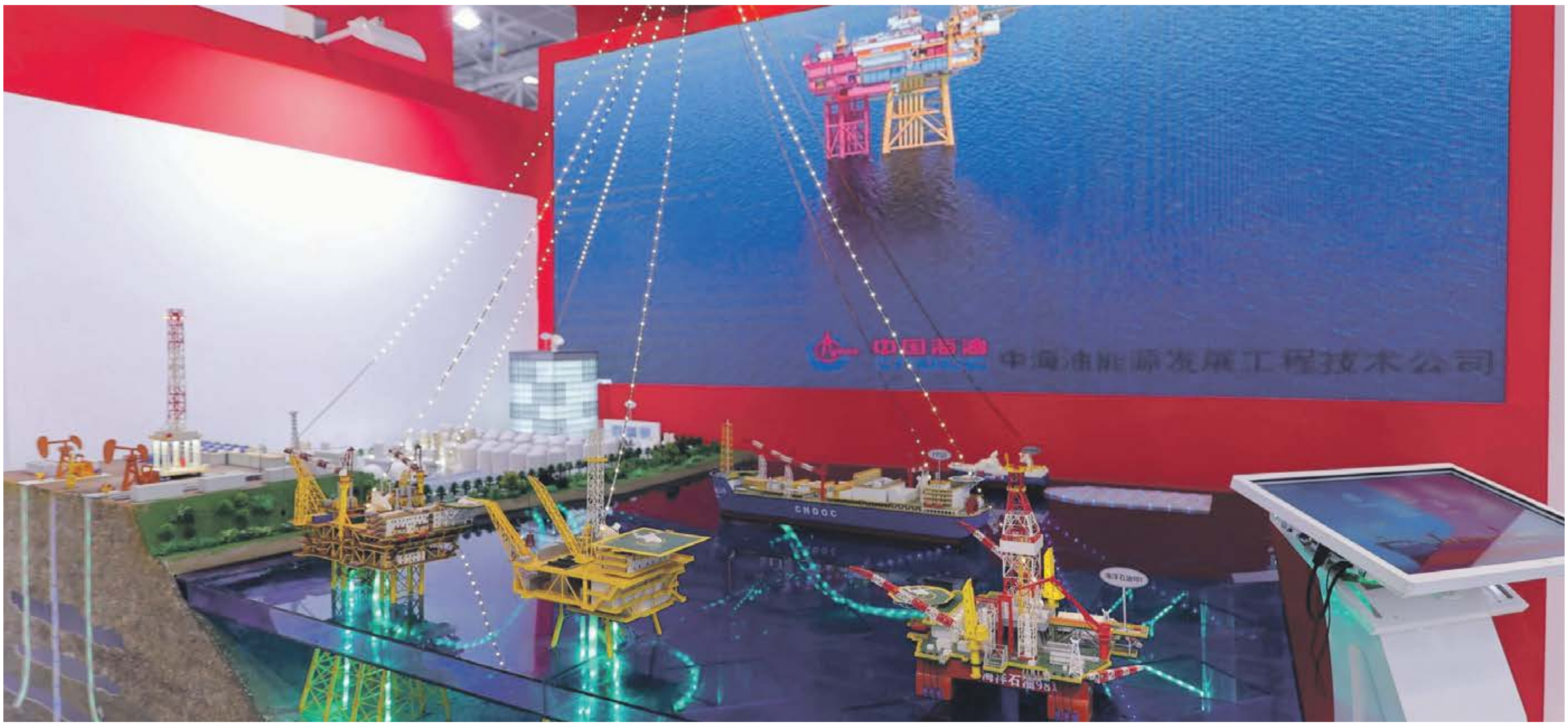
cippe2022
Concurrent Events Schedule

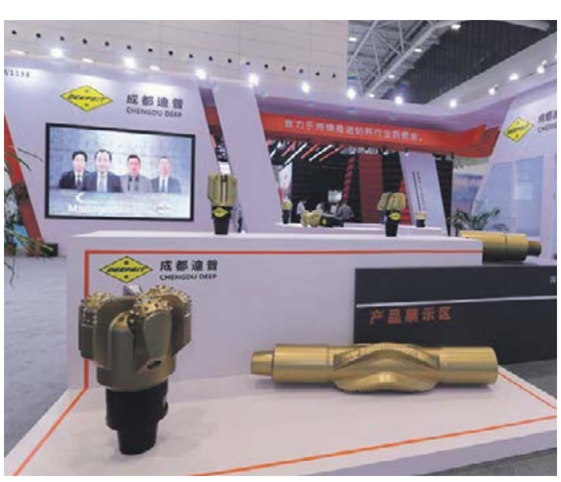
	时间 TIME	会议室 MEETING ROOM	主题 EVENT TOPICS	主讲公司及主讲人 SPEAKERS
29 July	09:30-11:20	17号馆会议区 Hall 17 Conference Zone	API 研讨会 API Standards and Certification Updates	美国石油学会 (API) American Petroleum Insititute (API)
	09:30-16:30	展馆 Exhibition Area	探馆直播 cippe Discoveries Livestream	中国国际石油石化技术装备展览会 (cippe) 组委会 cippe Organizing Committee
	09:30-11:00	17号馆会议区 Hall 17 Conference Zone	ECF 第七届页岩油气技术装备研讨会（深圳） The 7th ECF Shale Technology Showcase	上海联合非常规能源研究中心 Shanghai United Institute for Unconventional Resources (SUI)
	11:10-12:00	17号馆会议区 Hall 17 Conference Zone	新型压裂暂堵及水平井找水堵水系列产品 Series Products of New Fracturing Temporary Plugging and Water Finding and Water Shut-off Technology in Horizontal Wells	深圳凤皇能源发展有限公司 Shenzhen PHENIX Energy Development Co., Ltd.
	11:30-12:00	17号馆会议区 Hall 17 Conference Zone	重构想象— 水下可重构分布式混合智能平台 暨 鳍源水下机器人新品发布会 Reshape Your Imagination — Introducing a Reconfigurable, Combinable, and Distributed Intelligent Underwater Platform New Product Announcement in the FIFISH Underwater Robot Series	深圳鳍源科技有限公司 QYSEA Technology
	14:00-16:30	17号馆会议区 Hall 17 Conference Zone	中国石化海工锻件技术发展与供需对接会 China Forgings Supply and Demand Fair for Petroleum, Petrochemical and Ocean Engineering	中国锻造进出口联盟 China Forging Alliance for Import & Export 北京立基文化传播有限责任公司 Beijing Leegn Culture Co., Ltd.

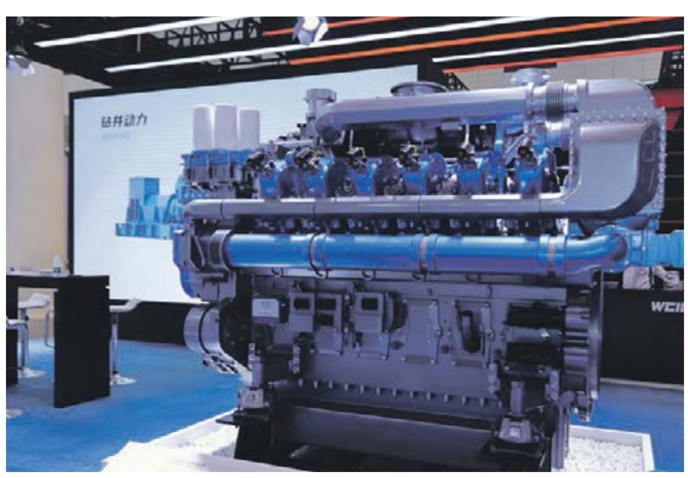
注：以上活动日程或有调整，以展会现场公布为准。 Note: The final agenda will be announced by the Organizing Committee on-site

Pictures from the show

Pictures from the show







INFRASTRUCTURE

Celebration: China celebrates the start of construction of the Power of Siberia trunkline Photo: AP/SCANPIX

China ready to launch gas pipeline expansion

By 2025, China plans to extend its massive gas pipeline grids to 163,000 kilometres, requiring capital expenditure of up to $1.9 trillion

XU YIHE
Singapore

CHINA is on the verge of a spending spree to expand the country's natural gas pipeline grids over the next four years to transport greater volumes to more clients and utilities.

Ding Zhimin, the former deputy director of the Policy & Law Department of the National Energy Administration, told a recent webinar that China will spend 11 trillion to 13 trillion yuan (US$1.6 trillion to US$1.9 trillion) to double the nationwide gas network to 163,000 kilometres by 2025.

Extravagant spending pledges on gas infrastructure reflects China's strategy to prioritise gas consumption, considered the most effective bridge fuel to bring emissions down before renewable energy can play a more significant role in the economy.

One of the pipelines under study is the second Russian gas import pipeline expected to extend to China via Mongolia from Russia's prolific gas fields in the Yamal-Nenets region, spanning 6700 kilometres. The pipeline, dubbed Sila Sibiri 2, is billed as offering capacity to deliver 50 billion cubic metres per annum of gas to the Chinese market.

In February, Gazprom also committed to transport 10 Bcm of gas per year from Russia's Sakhalin Island for the period of 30 years to China, with the project codenamed Sila Sibiri 3.

This is in addition to the 38 Bcm of pipeline gas exports per year by 2025 through the existing Sila Sibiri pipeline under a contract that was signed in 2014.

Russia is also considering boosting the throughput capacity of the Sila Sibiri pipeline to 44 Bcm from 38 Bcm, according to Liu Qian, executive vice director of the Russia-Central Asia Research Centre-attached China Petroleum University.

Investment and construction will be spearheaded by China Oil & Gas Pipeline Grid (PipeChina), a government-owned entity established in 2020 by grouping the oil and gas pipelines initially owned by China National Petroleum Corporation (CNPC), Sinopec and China National Offshore Oil Corporation.

The entity purports to centralise operation of the nation's massive oil and gas infrastructures including pipelines, terminals and storage tanks.

The country's top gas producer CNPC said that natural gas demand will peak at 650 Bcm by 2040, after which it will taper off to 410 Bcm in 2060.

The major drivers for gas demand growth were identified as power generation, industry utilities and construction.

Ding said that China's current gas pipeline network is "seriously inadequate" to meet the expected huge growth in gas demand. There are opportunities to invest in and build gas pipelines for private businesses as well as state-owned enterprises.

"The market potential is huge," she said.

China's gas consumption is expected to rise 8.2% year-on-year to 395 Bcm in 2022, with demand from the town gas sector forecast to increase by 12.9% to 124.4 Bcm. Industry will consume 160 Bcm, up 10.1% on the year, demand from the power generation sector will jump 11.4% to 73 Bcm, with the remainder to be used as feedstock for chemical production.

China's gas production will increase in line with the demand growth, but at a slower rate than imports.

CNPC said domestic gas production will rise to 250 Bcm in 2030 and further to 350 Bcm in 2060, up from 2021's 205.3 Bcm.

Of the total 395 Bcm gas consumption this year, almost 222 Bcm will come from domestic production, up 6.2% on the year, while 62 Bcm will be pipeline gas imports — up 6% — while liquefied natural gas imports will amount to 123 Bcm (88.6 million tonnes).

By the end of last year, China operated 84,000 kilometres of gas pipelines, dominated by three parallel west-east gas grids extending from gas deposits in Russia and other northeastern Asian countries as well as northwestern China to the markets in eastern and southern China

中国计划启动天然气管道网络扩建计划，瞄准提高俄罗斯进口

国家能源局法制与体制改革司原副司长丁志敏在最近的一次网络研讨会上表示，中国将耗资 11 万亿元至 13 万亿元人民币（合1.6万亿美元至 1.9 万亿美元），到2025 年将全国天然气管网总里程数翻一番，达到163,000公里。

中国计划对天然气基础设施投入巨额资金，体现了对天然气能源的重要战略地位，认为天然气是在可再生能源在经济中发挥重要作用前，降低碳排放量最有效的过渡燃料。

正在研究的管道之一是俄罗斯第二条天然气进口管道，预计将从俄罗斯位于亚马尔-涅涅茨地区的高产气田经蒙古输送至中国，全长6700公里。这条管道称为 Sila Sibiri 2，每年可向中国市场输送500 亿立方米天然气。

2月，俄罗斯天然气工业股份公司（Gazprom）还承诺在30年内每年从俄罗斯库页岛向中国输送100亿立方米天然气，项目代号为Sila Sibiri 3。

此外，根据2014 年签署的合同，到2025年，通过现有的Sila Sibiri管道每年输送380亿立方米的管道天然气。

俄罗斯中亚研究中心执行副主任刘乾称，俄罗斯还在考虑将 Sila Sibiri 管道的输送量从380亿立方米提高到440亿立方米。

国家石油天然气管网集团有限公司负责管网扩建的投资和施工。国家管网集团成立于2020年，是一家国有企业。

中国最大的天然气生产商中国石油表示，到2040年，天然气需求将达到6500亿立方米的峰值，之后将在 2060 年逐步降低至4100亿立方米。天然气需求增长主要来自发电、工业和建筑业。

ENERGY TRANSITION

China looks to clean up with enhanced oil recovery

Country is applying carbon capture technology to decarbonise operations and boost production at mature fields

XU YIHE
Singapore

Recovery: Sinopec applies CCS-EOR technology to its mature Shengli oilfield

CHINA has highlighted carbon capture and storage as one of the cutting-edge technologies in its effort to mitigate emissions from its own operations while pursuing renewable-energy development.

The country is home to massive undeveloped oil volumes held in low-permeability reservoirs, which provide a huge market for carbon dioxide-enhanced oil recovery applications.

CCS is also key to the decarbonisation of its oil and gas operations, with the added potential of creating new revenue streams.

The International Energy Agency recently said that CCS projects being planned worldwide will be able to capture and store 7.6 billion tonnes of CO_2 by 2050.

Data from the Global CCS Institute show that by the end of 2020 there were 65 commercial CCS projects worldwide with total capacity to capture and permanently store 40 million tonnes per annum of CO_2.

Of the total, 26 had begun operation, three were under construction, two had suspended operation, 13 were under front-end engineering and design study and 21 were in early stages of development.

Another 34 are under pilot development as demonstration projects.

Despite sporadic initiatives by its national oil companies to reduce CO_2 emissions with CCS, China will need central planning to provide a roadmap to address issues covering high cost, financial instruments, legal and regulatory framework as well as industry standards.

China now operates about 40 CCS projects in 19 provinces, with a CO_2 capture capacity of 3 million tpa.

Of the total, 13 are related to power generation and cement production, with CO_2 capture capacity of 860,000 tpa.

Eleven are involved with oil and gas production, with a capacity of 1.82 million tpa, including 1.54 million tpa used in EOR projects.

Most of these projects capture CO_2 from industrial sources such as plants producing gas-fired power, petrochemicals, coal-based chemicals or iron and steel.

One of China's national oil companies, Sinopec, is implementing 24 CO_2 EOR projects in China for a total of 25 million tonnes (183.75 million barrels) of oil in place.

The company's target of net-zero emissions by 2050 is significant, as Sinopec is the world's top refiner, with nameplate crude-distillation capacity exceeding 6 million barrels per day.

Sinopec says up to 1 billion tonnes of CO_2 emissions in China can be neutralised through carbon capture, utilisation and storage (CCUS).

In Shandong province, the company has launched what is claimed to be the country's largest CCUS project, which involves sending CO_2 captured at its Qilu Petrochemical complex to the Shengli oilfield, where it will be reinjected as part of an EOR programme.

The project aims to cut CO_2 emissions by 1 million tpa. The CO_2 will be sent to 10 unmanned reinjection stations to be built at the Zhenlizhuang sector of the Shengli oilfield for reinjection into 73 wells.

Sinopec expects to reinject 10.68 million tonnes of CO_2 there over the next 15 years, enabling oil production to increase by a total of 22 million barrels.

Last December, Sinopec completed a new CCS project in eastern China's Jiangsu province as part of its larger CCS-based EOR programme.

The new unit at Sinopec Nanjing Chemical captures CO_2 emitted from synthetic ammonia units and coal-to-gas units for reinjection into oil reservoirs at the Jiangsu field. Sinopec has now installed three such CCS units at Sinopec Nanjing Chemical.

They are designed to capture 200,000 tpa of CO_2, which is trucked to the Jiangsu oilfield's Huangqiao oil play.

The EOR scheme will scale up production by an estimated 1320 bpd.

Sinopec is also applying coal-to-gas CO_2 capture technology at the Shengli field, with a capture capacity of 700,000 tpa.

Shengli's oil recovery has increased by 15% where the technology has been applied, and CO_2 emissions have been cut by 30,000 tpa.

Chinese upstream giant PetroChina, meanwhile, is setting the pace for a large-scale deployment of CCS at its mature onshore fields.

PetroChina has embarked on a master plan to build four CCS-based EOR facilities by the end of 2025 at its Jilin, Daqing, Changqing and Xinjiang fields.

It is also building six pilot projects at the Liaohe, Jidong, Dagang, Huabei, Tuha and Nanfang fields.

When completed, the pilot projects will boost oil recovery by 28,000 bpd and inject 5 million tonnes of CO_2.

The company has endorsed a pilot in the Shuang 229 Block at Liaohe, where 3200 tonnes of CO_2 have already been injected.

PetroChina estimates that up to 500 million tonnes (3.6 billion barrels) of oil reserves are suitable for EOR through CCS technology at Liaohe, adding that the field's

Photo: REUTERS/SCANPIX

depleted reservoirs can store 8000 tonnes of CO_2.

At Shuang 229, PetroChina aims to increase oil production by 5560 bpd through injecting 500,000 tonnes of CO_2, increasing oil recovery by up to 30%.

This is part of a larger plan at Liaohe to boost output by 8000 bpd by injecting 1 million tpa of CO_2 by 2025.

PetroChina said the CCS project at Jilin is the largest in Asia, with the CO_2 injected to date exceeding 2 million tonnes. Five CCS-EOR pilot projects have been set up at Jilin focused on 86 million barrels of oil reserves.

PetroChina now injects 350,000 tpa of CO_2 at Jilin via 88 wells, which has raised oil production by 2000 bpd.

A larger plan calls for oil recovery to increase by 3000 bpd by injecting 1.2 million tpa of CO_2 by the end of 2025.

PetroChina started its CO_2-EOR pilot project at Jilin in 2009.

The field has been in decline for decades, with production falling to 80,000 bpd last year from 100,000 bpd eight years ago.

CNOOC Ltd is implementing China's first offshore CCS project at its Enping 15-1 oilfield complex in the Pearl River Mouth basin.

The scheme involves capturing up to 300,000 tpa of CO_2 and reinjecting it in a vault structure in the reservoir for storage.

Up to 1.46 million tonnes of caron dioxide will be captured and stored over the life of the field.

中国希望通过提高采收率技术推进实现脱碳目标

中国已将碳捕集和封存作为一项前沿技术促进减少自身碳排放量，同时不断追求可再生能源的积极发展。

低渗透油藏中蕴藏着大量未开发石油储量，为二氧化碳强化采油技术的应用提供了广泛的市场。

CCS 全球研究中心（Global CCS Institute）的数据显示，截至 2020 年底，全球共有 65 个CCS 商业项目，每年可捕集和永久封存4000 万吨二氧化碳。

其中，26个项目处于运营状态，3个在建，2个停产，13个正在进行前端工程设计研究，21个尚在开发初期。另有34个项目正在作为示范项目进行试点开发。

尽管国家石油公司时有项目采用CCS 技术来减少二氧化碳排放量，但中国依旧需要由中央统筹规划，明确指导解决包括高成本、金融工具、法律和监管框架以及行业标准在内等诸多问题。

目前，中国在 19 个省份运营了约 40 个 CCS 项目，二氧化碳捕集能力达到 300 万吨/年。其中，13个项目与发电和水泥生产相关，二氧化碳捕集能力为86万吨/年。11 个项目与油气生产相关，捕集能力为182 万吨/年，其中 154 万吨/年用于 EOR 项目。

这些项目大多在工业端进行二氧化碳捕集，例如燃气发电、石化产品、煤基化学品或钢铁的工厂。

作为中国国有石油公司之一，中国石化正在国内运营24个CO2EOR项目，预期石油资源量为2500万吨（合1.8375 亿桶）。中国石化表示，通过碳捕集、利用和封存（CCUS）技术，可在中国实现多达10 亿吨的二氧化碳排放中和量。

在山东省，这家公司已经启动了据称是中国最大的CCUS项目，将齐鲁石化综合项目捕集的二氧化碳输送到胜利油田，作为 EOR 项目重新回注。

此项目旨在减少 100 万吨/年二氧化碳排放量。捕集的二氧化碳将被送往正理庄油田规划建造的10个无人值守注气站，回注至附近73口井。

中国石化预计，未来15年，可累计注入二氧化碳1068万吨，可实现增油2200 万桶。

去年12月，中国石化在江苏省建成一个新的 CCS 项目，作为基于 CCS 技术的EOR 大型计划的一部分。

中国石化还在胜利油田应用煤制氢二氧化碳捕集技术，捕集能力为70万吨/年。这项技术得以应用后，胜利石油采收率提高了15%，二氧化碳排放量降低了30,000吨/年。

与此同时，中国上游巨头中国石油正着手在陆上老油田大规模部署 CCS技术。中国石油已着手制定整体规划，到 2025 年底在吉林、大庆、长庆和新疆油田建设四个采用CCS 技术的 EOR 项目。

它还在辽河、冀东、大港、华北、吐哈和南方油田建设六个试点项目。一旦完工，试点项目将提高石油采收率 28,000 桶/日，并回注 500 万吨二氧化碳。

中国石油已批准在辽河油田双229区块行试点，并已经注入 3200 吨二氧化碳。中国石油估计，辽河油田拥有多达 5 亿吨（合36 亿桶）石油储量适合使用 CCS 技术的 EOR项目，并补充说，该油田的枯竭油藏可封存 8000 吨二氧化碳。

辽河油田还有一项更大计划，旨在到2025年通过注入二氧化碳100万吨/年，从而实现增产8000桶/日。

中国石油表示，吉林的CCS项目是亚洲最大的，目前二氧化碳注气量已逾200万吨。目前，中国石油通过 88 口井在吉林油田实现注气量 350,000 吨/年，将石油产量提高了 2000 桶/日。一项更大的计划旨在到 2025 年底通过实现注气量 120 万吨/年，将石油采收率提高 3000 桶/日。

中国石油于2009年在吉林油田启动了“CO2–EOR”试点项目。该油田的产量几十年来一直呈下降走势，从八年前的 10 万桶/日降至去年的 8 万桶/日。

中国海油正在位于珠江口盆地的恩平15–1油田群联合开发项目运营中国首个CCS海上项目。该计划旨在每年捕集至多300,000 吨二氧化碳，并重新注入储藏的拱顶结构进行封存。全生命周期内，该油田预计捕集和封存至多 146 万吨二氧化碳。