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Winter | 2014
SPECIAL ISSUE

广东 CCUS 技术研讨会周

Guangdong CCUS Technical Workshop Week



中英 (广东) CCUS 中心
UK-China (Guangdong) CCUS Centre



第一届二氧化碳离岸封存研讨会摘要： 在广东建立海洋二氧化碳封存项目

Summary of Findings from the 1st Offshore CO2 Storage Workshop: Facilitating an Offshore CO2 Storage Programme in Guangdong

加拿大沙省电力燃烧后百万吨碳捕集，利用与封存项目的成功运行，为电厂大规模碳捕集项目开启了新的篇章。电厂碳捕集技术的普及需要积极的气候政策的支持和成本的下降，预计中国将会在上述两个因素扮演重要角色。

The successful operation of Sask Power CO2 Capture, Utilisation and Storage project, opens a new page for large-scale power plant capture projects. The wide deployment of CO2 capture from power plants would require two factors: stringent climate policy support and cost reduction, and China is estimated to play a vital role on these two factors.

广东 CCUS 中心在启动一周年之际，在 2014 年 12 月中旬举办了一系列研讨会。研讨会包括离岸地质封存，碳捕集装备，公众沟通与碳市场。我们很荣幸从英国，澳大利亚，挪威，美国和加拿大远道而来的专家访问广东和参与活动。本期杂志特别介绍了研讨会周的活动内容和得出的主要结论。

研讨会周回顾过去一年工作进展，为广东省未来的示范项目和研究工作提供建议。研讨会周的顺利进行得益于广东省发改委，英国驻广州领事馆，澳大利亚全球碳捕集与封存研究院，中海油深圳分公司，南方舆情研究中心，暨南大学新闻与传播学院，广东省电力设计研究院，中集安瑞科等机构的支持。

The CCUS Centre organized the CCUS technical workshops week in advance of the one year anniversary. The workshop covers offshore geological storage, carbon capture equipment, public communication and carbon market. We are very pleased that experts from UK, Australia, Australia, US and Canada to participate in the event and visit Guangdong. The current issue specially highlights the workshop activities and major conclusions.

The workshop week reviews 1-year progress, provides recommendations for CCUS demonstration and research activities in 2015. The workshops benefit from supports by Guangdong Development and Reform Commission, British Consulate General to Guangzhou, Global Carbon Capture and Storage Institute, China National Offshore Oil Corporation (CNOOC) Shenzhen, Nanfang Media Research, Jinan University School of Journalism and Communication, Guangdong Electric Power Design Institute, and CIMC Enric.



中英（广东）CCUS 中心技术研讨会周纪要

Minutes of UK-China (Guangdong) CCUS Centre Technical Workshop Week

8-13 Dec 2014

地点：广东省广州市，深圳市，东莞市，汕尾市
Guangzhou, Shenzhen, Dongguan, and Shanwei,
in Guangdong, China

目录 Contents

- 1 第一届二氧化碳海洋封存研讨会
1st Offshore International CO2 Storage Expert Workshop
- 33 有关公众沟通媒体专家座谈会
Media Public Communication Expert Workshop
- 53 海丰小漠镇中小学生交流活动
Primary and Middle Schools Workshops in Xiaomo, Haifeng
- 57 碳市场兼容性研讨会
Carbon Market Compatibility Workshop



Winter | 2014
二零一四冬季号

研讨会的顺利进行得益于广东省发改委支持，英国驻广州领事馆，全球碳捕集与封存研究院提供的资金支持，并由中海油深圳分公司，华润电力海丰公司，中集安瑞科，汕尾市海丰县小漠镇政府，南方日报和暨南大学提供资源投入支持。

The workshops benefitted from support from the Guangdong Development and Reform Commission, with financial contribution from the British Consulate General to Guangzhou and the Global Carbon Capture and Storage Institute, with further in-kind resource support by CNOOC Shenzhen, China Resources Power (Haifeng), CIMC Enric, Xiaomo Town Government in Haifeng Shanwei, Nanfang Daily and Jinan University.

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第一届二氧化碳离岸封存研讨会摘要： 在广东建立海底二氧化碳封存项目

Summary of Findings from the 1st Offshore CO2 Storage Workshop: Facilitating an Offshore CO2 Storage Programme in Guangdong

场地：中国广东省深圳市
Venue: Shenzhen, Guangdong, China
日期：2014年12月9日至10日
Date: 9 to 10 Dec, 2014



概要 OVERVIEW

在两天的二氧化碳封存研讨会中，中海油同事和国际专家回顾了过去由中科院南海海洋研究所与中海油深圳分公司合作的研究成果¹。专家确认其贡献，相信珠江口盆地能提供中国最大的二氧化碳封存机会之一。国际专家认为部分现有管道、钻井和平台等基础设施有可能被再利用，这些设施需要在拆除前尽快被评估。他们建议，未来还需进一步明确是否存在利用二氧化碳提高石油采收率的机会，并评估大规模咸水层碳封存的实际可行性，选出潜在封存地。国际专家也认为珠江口盆地进行传统二氧化碳地质封存的有效性还不确定²。这些不确定性需要通过进一步的地质工作进行研究，特别需要根据现有油气田的资料和进行取样测试来协助理解和认识盖层的质量。与会专家也认为需要制定一个全面的项目管理方案和封存工

During the 2-day offshore storage workshop, CNOOC colleagues and international experts reviewed past deliverables by the South China Sea Institute of Oceanology (SCSIO)¹. In acknowledging their knowledge contribution, experts stated their belief that the Pearl River Mouth Basin (PRMB) could provide one of China's largest opportunities for CO2 storage. International experts believed there were some opportunities for reuse of existing pipeline, borehole and platform infrastructure, and it is critical to assess the opportunities in advance of the decommissioning process. International experts recommended that further work is required to determine if CO2 EOR opportunities exist, to assess the practical viability of large scale storage in saline aquifers and to select potential storage sites. International experts also believed there is uncertainty about the effectiveness of conventional CO2 trapping for storage available in the basin offshore of Guangdong province. This

作计划³来为未来10年至20年在区域内评估及挑选二氧化碳封存点的工作提供基础。

¹ Zhou et al, 2011; GDCCUS, 2014

² Haszeldine and Senior, 2014

³ 例如，依靠中海油的项目管理方法，亚洲开发银行的CCS封存指南（Senior, 2014）和挪威船级社RP202和RP203建议最佳实践

³ e.g. building on CNOOC project management method and ADB CCS Storage Guideline in China (Senior, 2014) and DNV GL RP202 and RP203

珠江口盆地是中国南海北部最有潜力进行二氧化碳封存的地点，有3000亿吨有效封存能力。然而，这个封存能力预计是基于对区域和地方地质条件和有限的对象的一些初步的假设和研究。这是对本区域封存能力评估的第一步。会议中有不少的正面数据显示多个小型油气田有可能封存二氧化碳，一些现有的平台及管道已经具有二氧化碳防腐能力。然而，还需要大量的工作来确认实际的大规模封存潜力以及离岸通过二氧化碳充注提高石油采收率的机会和可行性，并为CCUS示范项目和长期推广提供稳健的封存点选择。北海和其他一些地区已采用了先进的、分阶段的方法研究盆地进行封存的可能性，珠江口盆地可根据本区域具体情况采纳这些经验。这样可以逐步减少不确定性，并在注入项目开始前进行越来越多的详细封存评估。国际专家指出，根据以往国际经验，封存能力、注入能力和密封性的调查和验证先于或与商业规模的捕集项目开发同时进行极为重要。

下一步需要在区域和局部层面上提高对珠江口盆地地质框架和封存潜力的认识。这需要利用油气数据、油气田数据，包括油藏地质和对油田圈闭的认识，以实现封存系统、

uncertainty needs to be addressed by a series of geological studies. Desk studies should be urgently conducted to compile information from existing hydrocarbon fields to understand and verify the seal quality. Attendees also considered it critical to develop a comprehensive project management framework and storage work programme to assess and select CO2 storage sites in the region to inform CCS activities over the next 10 to 20 years.

The Pearl River Mouth Basin (PRMB) in the South China Sea has significant potential for CO2 storage, up to perhaps 300Gt. However, this estimation is based on preliminary assumptions and studies of regional and local geology and limited datasets. This represents the first stage in assessing storage in the region. There was some initial positive data from the workshop showing that multiple small hydrocarbon reservoirs are present, with multiple storage targets and some platforms and pipelines constructed to resist corrosion from naturally occurring CO2. However, there is still a significant amount of work required to confirm the practical large-scale storage potential, the viability of any offshore enhanced oil recovery (EOR) opportunities, and to provide robust site selection for CCUS pilot or demonstration projects and long term deployment. A progressive, staged approach to developing the understanding of storage in a basin has been used in other regions, such as the North Sea, which can be adapted to suit the specific context in PRMB. This allows progressive reduction in uncertainty and more detailed assessment of storage prior to any injection project taking place. International experts noted that experience globally shows that it is important that investigation and validation of storage capacity, injectivity and seal proceeds together with, and usually ahead of, developments in commercial capture.

An improved regional and local field-scale understanding of the geological framework and storage potential in the basin should be developed in the next stage. This should use oil and gas datasets, oil and gas field information,

特别是盖层和断层的密闭质量的严格分析。应当为未来的封存选择（例如EOR、枯竭油田和咸水层封存）、封存机制、封存能力、注入能力、封存地选址评估打下基础。封存工作计划还应涵盖对二氧化碳提高石油采收率和设备、管道和钻井等基础设施再利用的机会的综合评估。此外，对离岸二氧化碳处理和注入的工程技术问题需要进一步评估：或通过管道连接每个注入平台，或采用船运二氧化碳；后者在早期的测试阶段、在还没有具备建设管道的信心时尤为有效。设立一个由中海油领导，由中英（广东）CCUS中心协调，有中海油深圳分公司、中科院南海海洋所等国内外机构和专家参与的海上封存工作项目是十分关键的。

including reservoir geology and an understanding of oilfield trapping, to rigorously analyse the storage systems and in particular to understand the seal quality. This should provide the basis for further assessment of storage options, (i.e. EOR, depleted fields, saline aquifers), storage trapping mechanisms, capacity and injection rate for each storage target, and for site selection. The storage work programme should also include an integrated assessment of CO2 EOR and infrastructure re-use opportunities, including facilities, pipelines and wells. In addition, the engineering aspects of offshore CO2 handling and injection requirements need to be assessed and implemented. That could be either at individual platforms supplied by pipelines; or by using CO2 shipping, which may be especially useful in early testing periods before sufficient confidence to build a pipeline has been established. It is critical to establish an offshore storage work programme through the UK-China (Guangdong) CCUS Centre led by CNOOC, supported by SCSIO and other Chinese and international institutes.

为了推进中国首个海洋地质二氧化碳封存
试注和示范项目、建议封存项目需要包括以下十项工作

For implementing the first offshore CO2 storage pilot and demonstration project, the storage programme needs the following 10 actions.

- 1) 一个完整的全链条项目管理框架，包括项目，数据和技术管理
Undertake a comprehensive full-chain project management framework, including project, data and technology management (3-month time duration).
- 2) 回顾再利用珠江口盆地的现有海洋石油基础设施的潜力，包括平台和管道
Review the potential to reuse existing infrastructure in PRMB incl. platforms and equipment, safety, wells and pipelines (6-month time duration).

- 3) 重新评估所选油田或油田的部分地区的二氧化碳提高石油采收率和封存的潜力。进行模拟来评估能额外开采的石油量。跨学科评估中还要包括对设施和钻井评估，对其从经济性进行筛选，评估其商业价值。

Re-evaluate the potential for CO2-EOR and storage in selected fields or parts of fields. Undertake simulation to assess the additional oil to be recovered. Incorporate facilities and wells in a multi-disciplinary assessment. Carry out an economic screening to understand if this has commercial value.

- 4) 利用（中海油）现有的油气田信息、完善的数据和区域性分析重新对珠江口盆地的封存潜力进行更详细的评估；并以此正式和挑选潜在的封存点。这可作为实现一体化示范项目和中期的里程碑。

Reassess the storage potential of the PRMB in more detail using existing hydrocarbon field information, well data and regional understanding in CNOOC. Use this to validate and select potential storage targets and sites. If necessary this can be tagged with interim milestones to meet any integrated pilot or demonstration programme activities.

- 5) 编制与二氧化碳注入和封存相关的盖层和储层信息。

Compile information on seals and reservoirs relevant to CO2 injection and storage.

- 6) 盖层：评估两到三个主要的区域性盖层的密封性，包括密封数据、油气储藏和油柱高度、岩性和厚度。发现密封数据的差距和潜在的数据获取方式。

Seals: review seal quality for two or three main regional seals including seal data, hydrocarbon trapping and column heights, regional lithology and thickness. Identify seal data gaps and possible data acquisition options.

- 7) 储层：结合对珠江口盆地的地层、岩相、储层质量、孔隙度、储层流体和可充注性的区域性研究来确认储层的封存能力和充注速率，并重新评估封存潜力。

Reservoirs: combine any real and vertical studies of stratigraphy, facies, reservoir quality, porosity, reservoir fluids and injectivity across the PRMB to validate capacity and injectivity rates of storage reservoirs and re-assess storage capacity.

- 8) 对封存风险（包括盖层、断层、已有钻井的密闭性）进行初步评估。

Conduct an initial assessment of storage risk (including top seal, fault seal, existing wells).

9) 根据实地和储层数据对所选情景和候选的示范封存地的二氧化碳注入、密封和封存进行三维模拟。

Conduct 3D dynamic modeling of CO₂ injection, trapping and storage for selected scenarios and candidate storage sites for demonstration based on field data, reservoir architecture, top seals, and fault seal analysis.

10) 通过以上研究选择和确定封存目标和封存地。制定并应用封存选址标准，选出用于试注和示范项目活动的封存点，并将此与捕集和运输活动结合起来。

Use these studies to select and confirm storage targets and sites. Develop and apply site selection criteria. Use this site selection to inform, scope and select pilot and demonstration programme activities. Integrate and align these studies with capture and transport activities.

为了让二氧化碳离岸封存成为中国东南部长长期大幅度减排二氧化碳的一个减排方案，所建议的封存项目需要以下 7 项工作（所需要时间待进一步讨论）

To enable CO₂ offshore storage as a longer term solution for deep CO₂ reduction in Southeast China, the programme requires (the time duration requirement needs further discussion)

- 通过取芯和实验室分析获得关于密封性的更多数据，包括岩心数据收集、测井分析、岩石物性分析，地下应力场和地质力学分析。

The acquisition of additional data on seal quality by coring and laboratory analysis, including core data collection, wireline log analysis, petrophysical analysis, subsurface field stress and geomechanical analysis.

- 进一步对珠江口盆地的区域性封存能力进行评估。

Further assessment of regional storage in PRMB.

- 评估并编制珠江口盆地的封存图集和数据库（为未来 CCS 的推广提供选择方案），利用透明且区域标准化的 GIS 数据库展示来实现封存地评估和选择。确保对数据质量的严格控制 and 可审核性，以供政府和潜在的封存运营商用于确定封存区域、不确定性和风险。逐步建立更庞大的封存评估信息基础，例如压力扩散、侧面和底层封堵性、基础设施可用性等。

Assessment and compilation of a storage atlas and database for the entire PRMB (to inform options for future CCS deployment). The use of a transparent and regionally standardised GIS database display to enable site rankings and choices. Data quality should be rigorously controlled, and an auditable system should be developed for government and potential storage operators to identify storage regions, their uncertainties, and their risks. This can progressively build up to much greater information on storage assessment – such as pressure dissipation, side and base seal, or infrastructure availability.

- 还需要评估地区构造和断层密封性或泄露风险。利用一系列地图或 GIS 数据说明这一更好的方式来展示结果。

The assessment might also include structure traps and fault seals, or the potential to leak to seabed. The interpreted results should be displayed as a series of maps, or better as GIS shapefiles with attributes.

- 为 CCS 的更广泛推广，对多个地点进行大规模注入的区域性模拟。Regional modeling representative of large scale injection at multiple sites should be conducted for widespread CCS deployment.

- 编制珠江口盆地的储层和盖层质量图，考虑数据的质量或不确定性。

Regional mapping of reservoir and top-seal quality across the PRMB. Consideration should be given to overlays of data quality and uncertainty.

- 为在珠江口盆地实现数十亿吨二氧化碳在多个场地的封存设计一个有效的注入和封存策略，包括封存位置和二氧化碳注入测试计划。这应与上述工作同时进行并每年更新。这将引导评估工作的正确性进行，指明需要重点关注的地理区域或具体问题，让它们得到解决。

A synthesis of research to design effective injection and containment strategies which could retain many Gt of CO₂ at multiple sites across the PRMB should be provided which can then be used to inform the locations of fluid or CO₂ test injection sites. This should be undertaken and updated at regular, perhaps annual, intervals. This will update and confirm the validity of the evaluation work, highlighting geographic regions or areas of concern where further work is required to provide similar levels of assurance.

目前广东省 CCUS 示范项目计划
Current Plan for the CCUS Demonstration Project in Guangdong

目前广东省 CCUS 示范项目的主要活动如下。因为本次研讨会提出了一些新的研究方向，中心会重新考虑第四到第十二项目部分的时间计划，以支持进一步的室内和实验室分析研究。

The current planned activities for the CCUS Demonstration Project in Guangdong can be summarized as below. The offshore storage workshop outlined new uncertainties in the project development. Consequently, the Centre should reconsider the project development timeline for items 5 to 12 with support from further desk and laboratory analyses.

碳捕集和非地质利用：
Capture and Non-geological Utilisation:

- (1) 进行海丰项目捕集中试基地建设
Undertake the construction of Pilot Capture Testing at the Haifeng Project
- (2) 进行二氧化碳捕集技术测试
Start testing CO2 Capture Technologies
- (3) 在 2016 年 6 月进行商业和创新二氧化碳利用技术的测试
Start the testing of Commercial and Innovative CO2 Utilisation Technologies in June 2016
- (4) 确定在海丰项目进行商业规模碳捕集的技术
Identify the most appropriate technology for commercial scale capture at the Haifeng Project

离岸运输和地质封存：
Offshore Transportation and Geological Storage:

- (5) 为试注项目设计运输系统
Design an offshore transport, injection and storage system for the pilot injection project
- (6) 开始进行试注入（按每年 25 万吨二氧化碳的级别），最好能示范二氧化碳提高石油采收率的潜力和再利用油田基础设施的可能性
Start pilot injection (at 0.25 million tonne scale), preferably to demonstrate CO2 EOR potential and the reuse of oilfield infrastructure

- (7) 确定进行广东省大规模一体化 CCUS 示范项目的合适封存地
Identify a promising storage site (greater than 300 Mt CO2) for the large scale integrated CCUS demonstration project in Guangdong

全链条因素：
Full-chain Issue:

- (8) 完成广东省大型一体化 CCUS 项目预可研初步报告
Complete the pre-feasibility study for the integrated CCUS project in Guangdong
- (9) 展开百万吨一体化前端工程研究
Start testing CO2 Capture Technologies in December 2015
- (10) 实现百万吨项目最终投资决定
Reach a final investment decision

长期因素：
Longer Term Issues:

- (11) 进一步评估和确认珠江口盆地二氧化碳封存能力
Further assess and validate CO2 storage capacity in PRMB
- (12) 设计捕集、运输和注入系统，沿着海岸线在其他大型工业排放源进行 CCUS 改造，连接海洋封存地
Design capture, transport and injection systems to retrofit CCUS on to other large point industrial sources along the coast line or along the Pearl River, linked to offshore storage

研讨会得出的地质认识 *Geology Information Provided at the Workshop⁴*

⁴Haszeldine and Senior, 2014

珠江口石油和天然气盆地多以薄层的形式存在，大约每个油田 10 层或更多。HZ21-1 油气田的最上层为带凝结油的气层。随着层级加深，气油比下降到较低 API 的重油，在较深层级二氧化碳浓度增高（2% 至 8%），这有可能显示甲烷气体的释放一直活跃至今。但由研讨会得出的信息显示油气在不同层位独立地储藏，而不是一个厚的垂直油藏。与会专家对此问题进行了争论，这个问题是基础性的和必须得到解决的。

生产过程中的压力下降情况显示这些储层是相互之间独立的，而不是一个垂直连接的构造。这隐含着关于珠江口盆地盖层质量的重要信息。研讨会给予的信息显示，除了 HZ32-3 油田以外，还没有足够的证据显示任何大于 10 至 15 米的石油柱可由一个独立的盖层容纳。有迹象显示很多小型的油柱而不是一个大的厚油柱。盖层的厚度和质量可能在盆地的每个区域差别很大，例如坳陷的中间有较厚和更好的盖层；但目前还没有证据来支撑此判断。对于目前建议进行 0.25 到 1 百万吨 / 年的 CO₂ 充注的油田，还没有证明其盖层能容纳比少量石油或二氧化碳更多的东西。

现有正在珠江口盆地浅水区域运行的石油天然气田显示珠江口盆地浅水部分的盖层质量需要评估。在一些具有构造圈闭的小油田只能储存数千万吨二氧化碳。而一个全规模的 CCS 项目在其生命周期内产生的二氧化碳

In the HZ21-1 field the oil and gas accumulations of the shallow water PRMB are in the form of multiple thin vertically stacked layers, maybe 10 or more per field. The uppermost layers are gas-prone, with some condensate, and a decreasing gas-oil-ratio downwards through lower API black oil, to become CO₂-rich (2-8%) in the deeper layers. That may be indicative of a long history of charging, with active charging of methane gas continuing today. reservoirs are sourced in individual layers. There was debate on this point – which is fundamental, and must be resolved.

During production, the pressure drawdown shows that these layers behave independently of each other - not as one vertically connected reservoir. This has profound implications for the seal quality in the shallow-water PRMB. From the information presented in the Workshop, there is not yet reliable evidence that a hydrocarbon column of greater than 10-15m is currently retained by an individual seal apart from in the HZ32-3 field. There appear to be many mini-columns, not one thick column.

It may well be that seal thickness and quality vary across the basin, with the centre of the sub-basins having thicker and better quality seals. However, at present there is no information on which to make this assessment. Currently the seals in oilfields where a 0.25 to 1Mt/year EOR commercial injection is suggested have not been proven to retain anything other than small oil or CO₂ columns.

Evidence from operating trapped hydrocarbon systems in shallow-water PRMB suggests that the seal quality across the entire shallow water PRMB



远远超过此容量，所以需要油气圈闭以外的封存空间。目前这些小油气田主要依赖珠江组上部作为盖层。另一个盖层是韩江组上部（中中新统上部）。

根据目前的资料，可能需要对珠江口盆地的泥岩盖层做进一步的分析才能为大规模封存提供足够的信心。在对常规封存地开展进一步评估工作的同时，更为谨慎的是也考虑非常规封存，即：(A) 带运移协助的封存。例如，模拟二氧化碳在深部注入，进入多个薄储层，在多个薄盖层之下和小圈闭内实现封存。这种非传统的路径能够通过剩余饱和及在孔隙水中溶解来实现有效的封存。(B) 在注入前溶解二氧化碳至孔隙水，创造一个较浓的二氧化碳卤水，使其不可能浮出泄露。亦即在平台上或在注入时在井下将 CO₂ 与地层水混合。目前以上两项技术在上世界上尚未被商业应用，其封存的可靠性也尚需被验证。

needs further analysis. In the area of small fields where there is structural closure and a trap, only tens Mt CO₂ could be retained. One full-size CCS project alone produces more CO₂ than this capacity during its operational lifetime, and so requires storage outside the oil and gas field trap areas. All of these fields appear to rely on the upper Zhujiang Formation as the top seal (uppermost early-Miocene), the most-likely primary seal for CO₂ trapping. Another possible CO₂ seal is at the uppermost Hanjiang Formation (upper mid-Miocene).

Given the present information, mudrock seals need further analysis to provide adequate confidence for retention of large quantities of CO₂ by conventional trapping across the PRMB. During the time that improved evaluation of conventional storage is undertaken, it may be prudent also to evaluate unconventional storage and its potential applications to this basin. Examples include: A) migration assisted trapping. For example, this could simulate the pathway of CO₂ from deep injection, through multiple thin reservoirs and retention by multiple small seals and small structure traps. Such dispersed pathways would promote very effective trapping by residual saturation and by dissolution into basin porewaters. B) pre-dissolution of CO₂ into porewater before injection to create a dense CO₂ brine not capable of buoyant leakage. This would mean mixing CO₂ with basin water on an injection platform or downhole during injection. Neither of these have yet been commercially applied or validated as secure storage by regulators globally.

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报告者名单
LIST OF SPEAKERS报告人员名单（按照发言先后顺序）
Speakers (in speech order)

梁希，中英（广东）CCUS 中心秘书长，爱丁堡大学副教授
LIANG Xi, Secretary General of UK-China (Guangdong) CCUS Centre, Senior Lecturer of the University of Edinburgh

陈晓芳，广东省发改委气候变化处高级官员
CHEN Xiaofang, Official of Guangdong Development and Reform Commission

宰培，英国驻广州总领事馆能源及气候变化处副处长
ZAI Pei, Deputy Head of Energy and Climate Change, British Consulate General to Guangzhou

陈澜，中英（广东）CCUS 中心主任，广东省电力研究设计院总工程师
CHEN Lan, Director of UK-China (Guangdong) CCUS Centre, Chief Engineer of Guangdong Electricity Design Institute

周蒂，中英（广东）CCUS 中心顾问委员会副主席，中科院南海海洋研究所教授
ZHOU Di, Deputy Chair of Advisory Panel of the UK-China (Guangdong) CCUS Centre Advisory Board, Professor of South China Sea Institute of Oceanology, Chinese Academy of Sciences

Bill Senior，中英（广东）CCUS 中心顾问，英国 CCS 资深顾问
Bill SENIOR, Advisor of the UK-China (Guangdong) CCUS Centre, Senior CCS Consultant Limited

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报告人员名单（按照发言先后顺序）
Speakers (in speech order)

Stuart Haszeldine, 中英（广东）CCUS 中心副主任，苏格兰 CCS 中心主任，爱丁堡大学教授
Stuart HASZELDINE, Deputy Director of UK-China (Guangdong) CCUS Centre, Director of SCCS, Professor of CCS at the University of Edinburgh

Mike Carpenter, 中英（广东）CCUS 中心顾问，挪威船级社 CCS 首席顾问
Mike CARPENTER, Advisor of the UK-China (Guangdong) CCUS Centre, Principle Consultant, CCS, DNV-GL

姜羲，英国兰卡斯特大学教授
JIANG Xi, Professor of Engineering, the Lancaster University

Bruce Hill, 首席地质学家，美国清洁空气组织
Bruce HILL, Chief Geologist, Clean Air Task Force

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John Sarlis, 壳牌康索夫公司首席技术执行官及副总裁
John SARLIS, Chief Technology Officer of Shell Cansolv

12月9日会议安排
AGENDA FOR 9TH DEC

08:45-09:00 注册与茶点欢迎
Registration and coffee welcome

09:00-09:15 会议开始致辞
Opening Speech

09:15-11:00 珠江口封存研究进展介绍
Introduction to carbon storage projects of Pearl River Mouth Basin

11:00-12:30 离岸封存项目介绍与平台改造
Introduction to offshore projects and platform retrofit

12月9日会议安排 AGENDA FOR 9TH DEC

14:00-15:20 海上平台与管道设计 - 国际经验介绍学习
Offshore platform and pipeline design
- international experience

15:20-17:00 封存试注经验与多项流体模拟研究
Pilot injection experience
and multiphase fluids investigation

17:00-17:30 第一天会议总结
Conclusion

会议进程 PROCEEDINGS

01 梁希副教授主持会议开始
Chaired by Dr LIANG Xi

02 广东省发改委气候变化处官员陈晓芳女士致开幕词
Opening speech by Ms CHEN Xiaofang from Guangdong DRC. She:

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| 1) 可持续发展是广东省必经之路，碳捕获利用与封存（CCUS）不可或缺 | 1) Affirmed that sustainable development is the necessary way for Guangdong. Carbon capture, utilization and storage is indispensable. |
| 2) 广东省碳捕获利用与封存发展历程回顾 | 2) Provided a history of CCUS development in Guangdong. |

03 英国驻广州领事馆官员宰培女士致开幕词
Opening speech by Ms ZAI Pei from British Consulate General to Guangzhou. She:

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| 1) 致谢社会各界对于 CCUS 发展以及中英（广东）CCUS 中心成立的支持 | 1) Thanked people from different sectors for their support for the development of CCUS and the UK-China (Guangdong) CCUS Centre. |
| 2) 追溯英国 CCUS 发展历史 | 2) Provided a retrospect of the history of CCUS in the UK |
| 3) 尽管困难重重，广东省发展 CCUS 技术潜力巨大，也是节能减排的必经之路 | 3) Stated that in spite of different barriers ahead, there is great potential for CCUS development in Guangdong. CCUS is of great significant for energy saving and emission reduction. |
| 4) 中英在 CCUS 技术方面有着密切的合作 | 4) Confirmed that the UK and China have a close bond in CCUS. |

04 中英（广东）CCUS 中心主任陈澜致开幕词
Opening speech by Mr CHEN Lan from UK-China (Guangdong) CCUS Centre. He said that:

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| 1) 中英（广东）CCUS 中心自成立以来成果丰富 | 1) There have been fruitful outcomes for the UK-China (Guangdong) CCUS Centre since its establishment. |
| 2) 今年五月顺利举行第二届 CCUS 国际会议 | 2) The 2nd International CCUS Conference was brought to a satisfactory close in this May. |
| 3) 华润海丰碳捕集小型测试平台项目顺利推进 | 3) The construction of pilot testing platform for carbon storage on China Resources Haifeng power plant is progressing smoothly. |
| 4) 中英（广东）中心于中海油密切合作推进珠江口碳封存项目 | 4) The UK-China (Guangdong) CCUS Centre has a close collaboration with CNOOC on carbon storage in Pearl River Mouth Basin |

05 中科院南海所周蒂教授介绍南海封存研究进展
Pro ZHOU Di introduced the research progress in South China Sea potential for Carbon Storage

珠江口地质背景介绍
Background of Pearl River Mouth Basin

1) 珠江口盆地是南海北部最大的盆地，从 1990 年开始产油，从 2009 年开始产气。油田面积通常比较小，但是成区域性聚集。预计 CO2 封存量可以达到 300Gt（有 77Gt 埋藏深度小于 300m）在 2010 年，广东省全省的大型 CO2 排放源排放量达到 180Mt CO2，大型点源分布在距离埋藏地 110~300km 的沿海。

2) 废弃油田筛选：
利用废弃油田可以减少时间和成本的投入。油田筛选的条件包括：可能应用 CO2-EOR，废弃时间早，存储能力大，良好的储盖组合等等。

3) CO2-EOR 应用潜力：
优势：珠江口产油为轻质油，有利于混相驱油。
缺点：油田面积小，边水地水能量大，一次产油率已经很高 (>50%)，离岸 CO2-EOR 非常困难。

1) The Pearl River Mouth basin is the largest basin in northern South China Sea. Oil production started in 1990 and gas production commenced in 2009. Hydrocarbon fields are small and clustered. CO2 storage capacity is estimated to be 300Gt (77Gt in shallow burial less than 300m sea water depth). In 2010, CO2 emissions from large point sources were 180Mt CO2 per year in Guangdong. The large point sources cluster about 110 to 300km from storage sites.

2) Depleted hydrocarbon fields:
Storage of CO2 in depleted hydrocarbon fields could reduce time and cost. Site screening criteria include: potential for CO2-EOR, early depletion, large capacity, effective reservoir-seal.

3) CO2-EOR potential:
Pros: Most oil produced from the Pearl River Mouth basin is light oil, which is effective for miscible CO2-EOR
Cons: The size of the fields is small, with strong water drive energy from connected aquifers. Primary production is already high (>50%). Offshore CO2-EOR is difficult.

可能备选封存地介绍
Candidate Sites

备选油田和咸水层 Hydrocarbon fields or saline aquifer	HZ32-3	HZ21-1	XJ23-1 上部咸水层 Upper saline aquifer
封闭面积 Trapping area	24km ²	10.5km ²	15km ²
OOIP	30Mt	16Mt	30Mt
埋深 Depth	1955~2280m	2820~3000m	1300~1700m
平台和井槽 Platform and well slot	四脚平台 / 12 个 Four-leg platform/ 12 well slots	四脚平台 / 15 个 Four-leg platform/ 15 well slots	八脚平台 / 24 个 Eight-leg platform/ 24 well slots
开始产油年份 Start production	2010	1990	1994
优点 Advantages	K22 油柱高度达到 42m，并且有一部分底水能量低 Column height of K22 is 42m. Low energy in one portion	接近产量极限，可能是最早废弃油田。 Possible the earliest to be depleted.	面积大，上部有 200m 区域盖层 Big area, with 200m thick regional seal
缺点 Disadvantages	低能量区域只有一口钻井，CO2-EOR 潜力不明显。 Only one well in low energy portion. Small potential for CO2-EOR	面积小，非均质，分层 Small area, heterogeneity, multi-layers	盖层性质以及附近断层需要进一步研究 More research on sealing capacity and faulting are needed

结论
Conclusion

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| 1) HZ32-3 有可能成为最可能的备选。 | 1) HZ32-3 might be the most favourable candidate |
| 2) XJ24-3 上部咸水层也有可能成为很好的存储地，但是盖层和断层的性质需要进一步研究。 | 2) XJ24-3 upper saline formations could be good storage sites. But further research on seals and faulting is needed. |
| 3) HZ21-1 可能较早废弃，并有气体处理设施，但储层埋深较深。 | 3) HZ21-1 might be depleted the earliest, and has a gas processing facility; but it is too deep. Multiple layers are separated. |
| 4) LF2-1 咸水层也有可能是很好的封存地，但是现在只有一口井。需要更多资料。 | 4) LF2-1 saline formations could be a good storage site. But there is only one well available. More information is needed. |

06 Bill Senior 介绍英国现有平台和管道改造再利用
Bill Senior introduced the topic of platform and pipeline retrofit for CO2 storage

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| <ul style="list-style-type: none"> • 利用废弃油气田碳封存介绍；利用废弃油气田的优缺点介绍 • 北海油气勘探历史介绍：开始钻探于1960年代，开始生产与1970年代，在2000年达到最高产量，CO2-EOR 驱油开始预测在2018-2020年。 • 英国油田生产设备 / 管线介绍：470个设备，10,000km 管线 • 碳封存项目介绍： <ul style="list-style-type: none"> Peterhead Miller 项目（由于缺乏政府财政支持而关闭） Kingsnorth 项目(Hewett 气田封存，由于 Hewett 气田被转卖而项目停止) | <ul style="list-style-type: none"> • Pros and cons for using depleted hydrocarbon fields. • Exploration history of the UK North Sea: commenced in 1960s; started production in 1970s; peaked in 2000; CO2-EOR was supposed to begin 2018 to 2020. • Introduction to the UK hydrocarbon production infrastructures: 470 installations; 10,000km pipelines. • Carbon storage projects: <ul style="list-style-type: none"> Peterhead Miller Project(stopped because of lack of government financial support) Kingsnorth Project(Hewett gas field storage. Project stopped because Project sponsor withdrew. Hewett field storage was transferred to new owner) |
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Longannet 项目 (Goldeneye 气田封存，因超预算停止)

White Rose 项目 (FEED, 2015 年完成)

Peterhead 项目 (FEED, 2015 年完成)

- 油气设备的在时间上的可用性很重要，有些生产设备已经停止使用，但是处理设备还在使用，所以不能应用于碳封存。其他重要考虑的因素应该包括设备使用年限，管道状态，经济性，转换后的安全性检测等。
- 从三个已经关闭的项目总结经验得出，碳封存项目需要得到政府在政策上和经济上的支持，需要大规模的首期投资和运行经费。

Longannet Project(Goldeneye gas field storage. Project stopped due to budget exceeding government funding. Project partners decided to cancel.)

White Rose Project(FEED, in progress to end 2015)

Peterhead Project(FEED, in progress to end 2015)

- When the hydrocarbon fields will be depleted is important. After depletion, some third party oil and gas processing infrastructure might still be reusable while the data could be used for CO2 storage evaluation. Other factors need to be taken into account including time expectation, pipeline status, commerciality, safety, performance, monitoring, etc.
- From past experience, carbon storage projects need strong political and financial support from government. They require a significant amount of capital and operational investment.

07 中科院南海所李鹏春副教授介绍南海封存地描述 / 运输 / 平台 / 钻井情况
LI Pengchun introduced progress in site characterization, transport, platform and well assessment

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| <ul style="list-style-type: none"> • LF2-1 是最大的背斜，可能适宜于封存，封存量达到356Mt，但是只有一口钻井。通过数学模拟得出，CO2 扩散范围为3km，压力上升小于0.9%。然而该处未出现天然油气聚集，所以密封性还不能确定。 • HZ21-1 为穹状构造，面积为10.5km²，预计封存量为1.4MtCO₂，在周边咸水层可封存69MtCO₂。 | <ul style="list-style-type: none"> • LF2-1 is the largest anticline structure. The storage capacity could reach 356Mt. But there is only one well available. From numerical modelling we can deduce that the CO2 dispersion area is 3km, and the pressure build up is less than 0.9%. However there is no natural trapping of hydrocarbon, so seal is not clear. • HZ21-1 is a dome structure, the trap area is about 10.5 km². From the model, the |
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- 运输类型：
 - 管道运输，HZ21-1 与 PY30-1 有一部分公用一段管线（20” 海底天然气管道 233km）
 - 船运：LPG 船改造 CO2 运输（低温低压 15bar, -35C）中国主要 LPG 船制造厂介绍
 - 平台：惠州油田群包括 8 个油田，联合开发的设备包括 7 个油田平台和 1 个天然气处理平台，2 个海下井口。
 - HZ2-1A 是产油平台，包括主要甲板，生活区，工作区（生产设备，泵，分离器等），低层甲板（存储管，排出设备等）。HZ21-1B 是天然气处理平台，包括分离 / 冷却 / 压缩 / 脱水等。
 - HZ21-1B 压缩机 / 卸载系统介绍。
 - HZ21-1 15 个井口介绍：6 个生产井，9 个废弃井。介绍中包括套管，管道系统，水泥封堵（抗腐蚀性）
 - 结论：HZ21-1 平台可用于 CO2 注入，离岸卸载系统需要做一些改进。由于 HZ21-1 和 PY30-1 公用管线，需要与周边的油气公司合作。
- storage capacity is 1.4Mt CO2 in hydrocarbon zones. The ambient saline aquifer could store 69Mt CO2.
- Transport type:
 - Pipeline: HZ21-1 and PY30-1 share one pipeline (20" subsea natural gas pipeline 233km)
 - Ship: LPG ship retrofit for CO2 transport (low temperature and pressure: 15bar, -35C) Brief of large shipyard in China
 - Platform: Huizhou oil fields cluster include 8 fields. Joint development facilities include 7 oil field platforms, 1 natural gas processing platform and 2 subsea wellheads
 - HZ2-1A is a production platform, including main deck, living quarters, working deck (production, pump, separator), low deck (storage tank, discharge devices). HZ21-1B is a gas processing platform, include separator/cooling system/compressor/dehydration system.
 - He provided a brief on the HZ21-1B compressor/unloading system.
 - He provided a brief on the HZ21-1 wellheads: 6 production wells, 9 abandoned wells. He described casing, pipeline system, cement (corrosion resistance)
 - His conclusion: HZ21-1 platform could be used for CO2 injection. But offshore unloading system needs retrofit. As HZ21-1 and PY30-1 share one pipeline, it needs consultancy with CNOOC.

- HZ21-1 总体情况介绍
 - 储量，技术可采储量，油田开采历史等介绍
 - 开采模式：联合开发，滚动开发。
 - 15 个井槽，全油气田井数 23 口
 - 油层已经快达生产极限，天然气仍然为生产提供发电
- A general introduction to the exploration background of HZ21-1
 - An introduction to OOIP, recoverable oil and exploration history
 - Production mode: joint development, progressive development
 - 15 well slots, 23 wellheads
 - He stated that oil production is approaching the limit. Still using on-site power generation for production activities.

- HZ21-1 油气田地理位置介绍：珠江口盆地北部珠一凹陷，小幅度披覆背斜。北部有一条东西向断层。
 - 地层介绍：含油气主要在新近系地层珠江组下部及珠海组上部，砂泥岩、粉砂泥岩和泥岩交替。珠江组上部为泥岩层。
 - 储盖层：油气田上部有两个凝析气藏，下部为八个油藏，均为背斜。平均孔隙度为 12.8-16.6%，平均渗透率为 68-317.3mD。
 - 气层油层之间有较厚区域性盖层，油层之间有局部盖层，个分层之间分割性良好。
- Introduction to the location: Zhu-1 depression is located at the northern of the Pearl River Mouth basin. It is a low relief anticline. There is an east-west fault in the north part.
 - Stratigraphy: oil bearing layers are mainly in the lower Zhujiang and upper Zhuhai Formations. Sandstone, siltstone and mudstone alternate. The upper Zhujiang Formation is mainly mudstone.
 - Reservoir-seal: two gas fields and 8 oil fields, all anticline. Average porosity:12.8-16.6%, average permeability: 68-317.3mD,
 - There is a regional seal in between the gas and oil fields. Local seal in between different oil fields. Oil fields are completely separated.

10 贾冰工程师介绍 HZ21-1 平台钻井完井
Jia Bing introduced HZ21-1 platform and well completion. He provided:

- HZ21-1 海底管线设计参数及运行情况
- 惠州油田联合开发群及设施分布
- HZ21-1 钻井平台 A/B 结构介绍
- 钻井及结构介绍
- 钻井工程的困难挑战
- HZ21-1 subsea pipeline design parameters and operational conditions
- An introduction to the Huizhou oil fields joint development and facilitates arrangement
- The layout of HZ21-1 platform A/B
- The structure of wells and boreholes
- The challenges for drilling wells

11 Stuart Haszeldine 教授介绍英国 CCS 研究中心和苏格兰 CCS 中心参与离岸封存项目
Stuart Haszeldine introduced UKCCSRC, and the practical work of the Scottish Carbon Capture and Storage Centre and offshore storage projects in which it is involved

- UKCCS 机构结构职能介绍
- SCGS 机构目标职能介绍
- SCGS 报告 1 介绍：英国北海 CCS 潜力研究。英国首个 CCS 项目：彼得黑得 Miller 项目。需要对整个北海盆地进行区域性研究。
英国第一个 CCS 研究项目：Peterhead Miller 项目。项目用时 24 个月，24 家公司、3 家机构以及政府参与研究，覆盖整个北海，最合适的首个封存地为 Captain 咸水层。包括几个油田和壳牌彼得黑得项目的 Goldeneye 气田，耗资 300 万英镑。
- SCGS 报告 2 介绍：英国 CCS 进展研究。耗时 4 年，50 万英镑，运用大量石油公司数据
- Objects and functions of SCCS
- The first report: UK North Sea CCS potential. First CCS project in the UK: Peterhead Miller project. CCS needed a better regional understanding of whole North Sea basin. The project lasted for 24 months. 24 companies and 3 institutes involved as well as Government. All of North Sea was mapped. Concluded that best objective for first storage site is the Captain aquifer. That includes several oilfields and Goldeneye gas field for Shell Peterhead project. Spend 3 million pounds.
- The second report: UK North Sea CCS progress This report took 4 years to complete. Spend quarter million pounds. Used a good amount of data and information from oil companies.

- SCGS 报告 3 介绍：多源头 CO2 封存研究。保证多源头 CO2 在咸水层封存。报告将于 2015 年 5 月出版。
- 英国 CO2 封存数据库：通过动态模拟的 CO2 封存相关数据（包括不确定因素和风险分析）都已经上传到 GIS 图上，可以在网上查询到
- Peterhead 项目介绍：英国北海 CO2 封存潜力为 700 亿吨，项目封存潜力为 4 千万吨 CO2，埋存深度为 3000m，封存地上部有三级盖层，能确保安全存储。项目应用原有的平台和管道翻新。预计整个封存工作的实现需要 120 个工作人员 20 年的努力来完成。
- The third report: CO2MultiStore. Research on CO2 storage from multiple point sources, injected into one aquifer. It will be published in May, 2015.
- UK CO2 storage database was launched: CO2 storage data modified by dynamic modelling data, including uncertainty and risk analysis classified by severity level. All the data has been uploaded to a GIS map, and is available online now.
- Peterhead project introduction: UK North Sea CO2 storage potential is 70 billion tons in total. Peterhead project could store 40 million tons of CO2. Storage depth is about 3000m, with three seals to secure. This project uses existing platform and pipelines after many refurbishments. To undertake just this one storage evaluation project is estimated to require 120 different staff, with a total of 20 person-years work.

12 Mike Carpenter 介绍 DNV-GL 和 RP-J202 和 RP-J203
Mike Carpenter introduced DNV-GL and RP-J202, RP-J203

- DNV-GL 公司介绍
- Mongstad 挪威项目介绍
- CO2PIPETRANS 项目介绍：CO2 泄露测试实验，感应检测实验，管道测试实验，高浓度 CO2 腐蚀实验，裂缝柔韧性试验。实验测试结果表明温度的不同可以引发非常大的差异。
- RP-J202 和 RP-J203 内容和应用介绍
- 技术 - 经济性分析模型
- 台湾新项目介绍
- Introduction to DNV-GL
- Introduction to the Mongstad project in Norway
- CO2PIPETRANS project introduction: CO2 leakage experiment, sensor experiment, shock tube commissioning test, high density CO2 corrosion experiment, ductile fracturing experiment. All the test data is available online. One degree could result in a big difference.
- Introduction to RP-J202 and RP-J203.
- Tech-economic analysis model
- Introduction to a new project in Taiwan

13 姜羲教授介绍数学模型法对地质碳封存研究： 杂质的影响与大规模仿真研究

Jiang Xi introduced numerical investigations of carbon storage: impurity effects and large scale simulation

- 模型建立背景：达西定律，质量守恒定律，能量守恒定律
- 粘性指进模型介绍：CO₂ 溶解 - 扩散 - 对流过程导致了粘性指进现象。
- N₂ 和 SO₂ 杂质对于 CO₂ 在地下运移的影响：三个阶段（扩散主导，对流主导，对流减弱）。实验结果表明，N₂ 浓度对于 CO₂ 的溶解负相关，SO₂ 浓度对于 CO₂ 的溶解正相关。
- 大规模多层地质模型仿真介绍：CO₂ 注入后三年与十年溶解状态模拟。模拟研究的主要意义在于更加加深对于 CO₂ 流体在多空介质中流动状态的了解。
- Modelling background: Darcy's law, mass conservation, energy conservation
- Viscosity fingering: CO₂ dissolution-diffusion-convection
- N₂ and SO₂ migration underground: three steps (diffusion dominated, convection dominated, convection decay). The result shows that the concentration of N₂ is negative to the solubility trapping mechanism, whereas SO₂ is positive.
- Introduction to large-scale simulation: 3 years and 10 years after CO₂ injection. The significance of a simulation study is to deepen the understanding of the fundamental problems in porous medium flows.

14 魏宁教授介绍 CO₂ 陆上咸水层封存的预可研研究结果

Wei Ning introduced CO₂ onshore storage in saline aquifers

- 中国 CO₂ 排放源与封存地潜力对应性的研究：中国的排放源多集中在东部沿海地区，而陆上封存潜力主要在西北地区，点源匹配性不好
- 封存地预可研研究框架体系介绍
- 封存运输管道和注入平台的选择
- 封存技术 - 经济模型介绍与项目成本估算过程介绍
- Study of CO₂ emission source-storage site match: most emission sources concentrate in coastal areas, but onshore storage sites concentrate in north-west area. The source-point match is not good enough.
- Introduction to the flow diagram of onshore storage site selection prefeasibility study.
- Introduction to the tech-economic model and project cost estimation process

- 项目风险评估方法
- 咸水层离岸封存大型项目可以适当减小预算
- Methodology for risk analysis
- Large-scale offshore storage in saline aquifers could cut down costs.

15 Bruce Hill 介绍 CO₂-EOR 创新方法

Bruce Hill introduced an innovative CO₂-EOR method

- 美国清洁空气组织职能介绍
- 北美稳定碳排放源分布点，点源匹配性分析
- BOEM 项目介绍（海洋能源管理机构）：CO₂ 封存在北美外大陆架的耗资和收益分析报告
- 北美外大陆架的封存潜力为 3600Gt。报告中还对于单纯碳捕集，碳捕集加外大陆的碳封存，以及碳封存结合碳驱油的经济效益做出了对比。
- CO₂ 驱油新技术：残余油回收技术
- CO₂-EOR 的应用可以增加石油产量，同时推动 CCS 的发展。CO₂-EOR 新方法使得生产与封存达到最大化。
- He explained the function of the American Clean Air Task Force
- North American stable emission source and storage potential analysis
- Introduction to the BOEM project (Bureau of Energy Management): analysis of costs and benefits of CO₂ storage on the US outer continental shelf (OCS)
- The storage potential of the OCS is about 3600 Gt. The project report gives the cost and benefit comparisons of carbon capture, carbon capture plus OCS storage, OCS storage plus CO₂-EOR.
- CO₂-EOR innovation: Residual Oil Zone recovery (ROZ)
- CO₂-EOR could boost oil production and drive the rapid deployment of CCS. The utilization of innovative methods could optimize the production and storage.

残余油回收技术目的是把水油交界线下部分的残余油驱出。残余油的成因一般是区域性的倾斜，盖层突破后期由重新封堵，或者下部水含水层流动造成的。新技术已经被证实可以得到更高的石油产量，并且没有 CO₂ 泄露的迹象。但是现在的技术难点在于如何寻找残余油。

The object of ROZ is to tap the oil below the oil-water contact. The formation of ROZ is normally from regional tilt, from a trap which was breached and later healed, or from the changed conditions of the underlying aquifer. This new technology is proved to recover more oil with no leakage. But the difficult point is how to find ROZ.

12月10日会议安排
AGENDA FOR 10TH DEC

- 08:45-09:00 茶点欢迎
Coffee welcome
- 09:00-09:15 会议开始致辞
Opening Speech
- 09:15-10:20 碳封存国际经验介绍
International experience in carbon storage
- 10:20-12:15 油田改造分组讨论
Panel discussion



会议进程
PROCEEDINGS

- 01 周蒂教授主持当日会议开始
Pro Zhou Di chaired the meeting.
- 02 Bill Senior 先生介绍中国岸上封存与离岸封存对比
Bill Senior introduced on-shore and off-shore carbon storage in China

- 中国 CO2 排放源与封存地关系分析：岸上封存地主要在北方，但是 CO2 排放源集中在东南沿海
- Source and storage point match analysis: onshore storage sites are located in North China, but large-scale CO2 emission sources accumulate in south-east coastal regions.
- 通过 Snøhvit 项目经验，岸上封存地渗透性小，分区严重，压力上升快，不适合大规模 CO2 封存充注，最好有备选方案。
- From lessons learned from Snøhvit, storage sites with low permeability and highly compartmentalized characteristics could result in fast pressure build-up, which is not suitable for large-scale CO2 storage. Important to have a backup Plan B.
- 分区可能成为中国陆上油田封存的一大问题，因为存在大量断层和地层分区。
- Compartmentalization likely to be of concern for EOR and storage in onshore Chinese oilfields because of extensive fault and stratigraphic compartmentalisation.
- 对比得出，离岸碳封存对于中国是更好的选择
- Comparatively, offshore carbon storage is a better choice for China.

03 Peta Ashworth 女士澳大利亚碳封存重点项目介绍 Peta Ashworth introduced large-scale carbon storage projects in Australia

- CarbonNet 项目介绍：封存能力为每年 100-500 万吨 CO2，封存地点在 Victoria 东南部的 Gippsland 盆地。现阶段项目已经通过了三个可能性封存地的可行性分析报告。
- Gorgon 项目介绍：陆上封存，封存地在澳大利亚西部的 Barrow Island, DupuyFm。预计于 2016 年开始碳捕集运行。
- South West Hub 项目介绍：封存地位于澳大利亚西部的 Harvey 地区，捕集能力为每年 250 万吨 CO2。项目碳捕集开始运行时间预计在 2020 年开始运行。
- CarbonNet Project: storage capacity of 1-5 million tons per year of CO2. Storage site is in Gippsland basin, south-east of Victoria. At present stage, the prefeasibility study of 3 potential storage sites has been approved.
- Gorgon Project: onshore storage on Barrow Island, Dupuy Formation in Western Australia. It is estimated to begin operation in 2016.
- South West Hub Project: Investigating the potential for storage of CO2..... CO2 in Harvey, Western Australia. The capture capacity is 2.5 million tons of CO2. Operations begin in 2020.

04 John Sarlis 先生加拿大边界大坝项目介绍 John Sarlis introduced the Boundary Dam Project in Canada.

- 壳牌康索夫公司历史和运行模式介绍：致力于减少污染排放，拥有 20 个运行中大型项目。
- 壳牌康索夫脱碳脱硫技术介绍及对比：可以达到严格的排放标准，工艺简单易操作，
- History and operation mode of Shell Cansolv: great effort in emission reduction, involved in 20 large-scale projects
- Introduction of Shell Cansolv SO2 and CO2 remove technology: can meet most strict emission standards with very simple operation.

- 商业运行实例：中国国电都匀电厂脱硫制酸项目（2013）；南非 LANXESS CANSOLV 二氧化碳捕集装置；边界大坝 150MW SO2/CO2 捕集项目；英国 Peterhead CCS 项目
- 边界大坝碳捕集项目：项目与 2014 年十月开始运行，年捕集量为一百万吨 CO2。壳牌康索夫提供捕集技术。运用第二代可再生胺技术先经过脱硫技术，得到 SO2 被卖到硫酸厂制造硫酸。
- 项目成本随着经验的积累、项目规模的扩大、以及技术的革新而降低。Peterhead 将运用康索夫研发的第三代溶液，海丰项目将会与 Peterhead 项目应用同一种溶液。
- Commercial projects: Duyun power plant SO2 removal project (2013); South Africa LANXESS CANSOLV CO2 capture project; Canada Boundary Dam 150MW SO2/CO2 removal project; UK Peterhead CCS project.
- Boundary Dam Project: the project began in Oct. 2014. The total capture capacity is 1 million tons of CO2 per year. Shell Cansolv provides the second generation of regenerative amine technology. The scrubbed SO2 will be sold to a sulfur plant.
- With the enlargement of the project and technology innovation, the project cost declines. The Peterhead project (as well as the Haifeng project) will use the third generation technology, which is more economic and effective.

05 分组讨论 Panel Discussion

小组 1：惠州平台改造与再利用讨论（地点：C 座 2 楼明勤厅）
*Group 1: Retrofit and reuse for Huizhou platform
(location: Endeavour Room, 2nd floor, Block C)*

李佳博士总结讨论结果，以下 4 点在以后的工作中需要研究：
The results of the discussion were presented by Li Jia.
The following 4 points should be the focus of future study:

- 压缩机从天然气向 CO2 压缩机的改造
- CO2 卸载系统要求：由于环境多变的因素，每天只有 4 个小时适合卸载运行
- 注入平台对于 CO2 质量的要求
- 法律和规章的要求，事故责任归属问题讨论

- The changes needed for compressor retrofit for CO2 injection.
- The requirements for offshore unloading systems: because of the changeable climate, there is only a 4 hours slot available for unloading.
- Requirements for CO2 quality for injection
- Legal and regulatory requirements for operation. Who is taking the responsibility?

小组 2：管道改造以及运输检测（地点：C 座 2 楼勇士厅）
Group 2: pipeline reuse and monitoring
(location: Warrior Room, second floor, Block C)

Mike Carpenter 总结发言。讨论结果有以下几点需要解决：
The results of the discussion were presented by Mike Carpenter.
The following points need to be studied:

- 现有管道是否适合于运输高浓度 CO2
- CO2 运输的纯度要求是多少？
- 管道运输监测要求是什么
- 管道的清洁方法是否如同天然气运输管道？
- 现有管道的腐蚀程度是否适合运输 CO2
- 是否用船运是更为可行的选择？因为 HZ21-1 和 PY30-1 有一段公用管道，而 PY30-1 正在运行中。但是中海油的李小龙经理指出，PY30-1 与 HZ21-1 公用管道可能将会在未来几年内弃用，现在正在为 PY30-1 修建一条新的运输管道。如果旧管道被弃用，便有可能用于运输 CO2

- Whether the existing pipelines are suitable for dense phase CO2?
- What are the purity requirements for the CO2 stream?
- What are the pipeline integrity monitoring requirements?
- How to clean up the pipelines? Is the method the same as for the Goldeneye pipeline?
- Whether ship transportation is the more suitable choice? As HZ21-1 and PY30-1 share one pipeline, and PY30-1 is still in service. Li Xiaolong from CNOOC pointed out that the shared pipeline might be decommissioned in the future. A new pipeline service for PY30-1 is under construction. In this case, the depleted decommissioned pipeline could be used for CO2 storage in HZ21-1.

小组 3：封存地选址评价（地点：明瑞厅）
Group 3: storage sites selection and evaluation
(location: Auspicious Room, Block C)

Stuart Haszeldine 总结发言。讨论结果需要解决的几个问题包括：
The results were summarized and presented by Stuart Haszeldine.
The following points should be the focus of future study:

- 封存地上部盖层是否可靠？局部盖层的分布在哪些区域？如果应用油田之间的咸水层封存的话，是否有泄露风险？
- 有些断层是封闭的，有些是开放的，甚至一直延伸至海床。断层的封存也存在不确定性。
- 储层的可充注性是否足够？是选择深层充注还是浅层充注？选择几口井作为注入井？
- LF32 油田有很大的日产量和局部盖层，也许也能成为候选地。
- 现阶段需要做的工作包括：
 - a. 整合区域性盖层的资料，研究盖层的质量确保安全性
 - b. 了解断层的岩石物理性质，确认其开放还是封闭
 - c. 建议中海油需要建立一个专项小组来做碳封存项目
 - d. 李小春教授建议把二氧化碳驱油也要同时考虑。
- Whether the upper seal is reliable? The distribution of the regional seal is unsure. The likelihood of leakage if the saline aquifers in between the hydrocarbon fields are used for storage needs further investigation.
- Faults are either opened or closed. The displacement reaches the seabed for some faults. The likelihood of leakage from faults is in question.
- Whether the injectivity is good enough? Injection from deep layer to get more dispersion, or from shallow layer to get higher rate? How many wellheads to choose for injection?
- LF32 oil field has large production rate and regional seal. It might be candidate for storage.
- Future work should include:
 - a. Compiling the information of the regional seal to secure the storage.
 - b. Understanding the rock mechanics of faults to confirm whether they are open or closed.
 - c. It is suggested that CNOOC could establish a focus group for carbon storage project.
 - d. Pro. Li Xiaochun suggested including CO2-EOR into consideration.

中英（广东）CCUS 中心技术研讨周
广东省国际 CCUS 媒体和沟通工作会议：
新形势下探索项目开发者与公众沟通的有效模式
UK-China (Guangdong) CCUS Centre Technical
Workshop Week 1st Guangdong CCUS Media and
Communication Workshop: Investigate an Effective
Model to Communicate with the Public in China

场地：广东省广州市暨南大学第二文科楼 519 报告厅
Venue: Jinan University, Guangzhou, Guangdong
日期：2014 年 12 月 11 日
Date: Dec 11, 2014



报告者名单
LIST OF SPEAKERS

报告人员名单（按照发言先后顺序）
Speakers (in speech order)

梁希，中英（广东）CCUS 中心秘书长，爱丁堡大学副教授
Xi LIANG, Secretary General of UK-China (Guangdong) CCUS Centre, Senior Lecturer
of the University of Edinburgh

范以锦，暨南大学新闻与传播学院院长
Yijin FAN, Dean of the School of Journalism and Communication, Jinan University
to open the workshop

蓝云，南方日报社代表南方舆情研究院秘书长
Yun LAN, Secretary General of the Southern Public Opinion Research Institute, Nanfang Daily

林千果，澳大利亚全球碳捕集与封存研究院官员
Qianguo LIN, Global Carbon Capture and Storage Institute Official

林亚茗，南方日报社
Yaming LIN, Nanfang Daily

Peta Ashworth, Ash 咨询公司
Peta Ashworth, Ash Research

Jessica Morton, 全球碳捕集与封存研究院
Jessica Morton, Global Carbon Capture and Storage Institute

曹斯，南方日报社
Si CAO, Nanfang Daily

朱和平，中英（广东）CCUS 中心示范项目负责人，华润电力（海丰）电厂技
术副总监
Heping ZHU, Leader of CRP Haifeng Power Plant CCUS Demonstration Project

12 月 11 日会议安排
AGENDA FOR 11TH DEC

13:45-14:00 注册与茶点欢迎
Registration

14:00-14:30 会议开始致辞
Opening Speech

14:30-14:50 国际项目的公众沟通经验
International Specific Project
Communication Experiences

14:50-15:10 全球碳捕集与封存研究院
国际项目的公众沟通经验
Lessons and Experiences Learned
from GCCSI CCS Projects

15:10-15:30 国内媒体在沟通中起到的作用
与广东 CCUS 基准线调查结果
以及对公众交流活动的启示
The role of the Media in Public Communication,
the Findings of the Guangdong CCUS Public
Baseline Survey and the Implications for Public
Communication Work

15:50-16:50 圆桌讨论：
新形势下项目开发商与公众沟通的模式
Round-table discussions:
Effective Models to Communicate between
Developers and the Public in the New Era

会议进程 PROCEEDINGS

01 梁希副教授主持会议开始
Chaired by Dr LIANG Xi

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| <p>1) 希望通过今天的研讨会形成一个连接公众、项目开发商和专家的桥梁;</p> <p>2) 公众在项目开发的作用和影响力越来越大, 近期广东省有不少的大型基建项目受到公众的压力而被延迟或取消, 所以如何在项目建设过程中与公众形成一个良好的桥梁, 西方过去的一些经验和方式能给我们带来借鉴;</p> <p>3) 希望通过这个活动为温室气体排放和 CCUS 技术在公众、媒体和传播上的认识提供良好的基础。</p> | <p>1) To link different stakeholders in CCUS, such as the public, project developers and research experts;</p> <p>2) To understand the increasing importance of the public in terms of shaping government policy and shortlisting projects. Due to pressure from the public, the government has changed its mind in relation to projects. We can also refer to international experience to enhance our work.</p> <p>3) Jointly find a way to communicate with the public on CO2 emission reduction and CCUS technologies.</p> |
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02 暨南大学新闻与传播学院院长范以锦教授致开幕词
Opening speech by Prof. Yijin FAN,
Dean of the School of Journalism and Communication, Jinan University

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| <p>1) 代表暨南大学新闻与传播学院对所有参会者表示欢迎, 新闻院做新闻传播教学的, 学生接近 2000 人, 有一批老师和学生做传播研究工作。</p> <p>2) 近几年环保的传播非常重要, 因为环保的项目是利国利民的大事, 需要去宣传。而在今天的全媒体时代, 几乎有重大环保问题的项目都会由于公众沟通缺乏和社会舆论的推动, 引发舆论事件。</p> <p>3) 今天的主题是——关于二氧化碳的捕集和封存在海底的项目, 必定会引起公众关注, 需要媒体进行引导。《南方日报》在座的林亚茗和曹斯记者写的《“海葬”二氧化碳》很令人瞩目。</p> | <p>1) It is an honor to address this workshop in Jinan University as they are specialized in research into journalism and communication with a faculty of 70 teaching staff, and 2000 students incl. undergraduate, postgraduate and doctoral students.</p> <p>2) Journalism is playing a more important role for CCUS. The media needs to be engaged in all natural and environmental projects which create a storm of media coverage because when we talk about a certain large scale project with potential environmental impacts, public perception and opinion will be of great influence for the project and government.</p> <p>3) This workshop is about CO2 capture and offshore storage projects, and the media can do a lot to influence public opinion. Some of the journalists here, Ms Yaming LIN, and Ms Si CAO, have written some great articles regarding storage of CO2 under the seabed.</p> |
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03 南方日报社代表南方舆情研究院秘书长蓝云致开幕词
Opening speech by Mr. Yun LAN, Secretary General
of the Southern Public Opinion Research Institute, Nanfang Daily

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| <p>1) 环境、环保是世界各国普遍关注的的话题, 在此过程中新科学技术起到了很大作用。今天讨论的主题, CCUS (碳捕集、利用与封存) 技术也是应对全球气候变化的关键技术之一。</p> | <p>1) The environment and environmental protection is important around the world, and innovation plays a key role in this field. The CCUS technology is also one of the key technologies to deal with climate change.</p> |
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- 2) 介绍所在机构—南方舆情研究院。今年年初，由南方报业传媒集团联合包括暨南大学等等的国内更大高校智库、研究机构发起，这是中国首家专注于治理现代化课题的复合型智库，也是致力于广东改革发展稳定大局，探索广东治理现代化路径的首席舆情服务平台。最近研究院针对核电项目、垃圾焚烧、PX 环境问题等事件的舆情态势开展相应的专题研究。
 - 3) 个人邀请了律师、科技或媒体工作者、知名网友参会，他们也代表了广东民间层面对环保的关注及对本次会议的支持。
- 2) He introduced the Southern Public Opinion Research Institute which was established in response to the development and reform, and overall governance system and capacity in Guangdong, by the Nanfang Media Group, together with several think tanks, and higher education institutes in China to look at the system of modern governance in China. They were recently working on trends in public opinion concerning various research projects including nuclear, incineration, and PX.
 - 3) Mr Lan has personally invited some guests and friends from new media, law firms and well known internet commentators on behalf of the public in Guangdong.

04 澳大利亚全球碳捕集与封存研究院官员林千果致开幕词 Opening speech by Qianguo LIN from Global Carbon Capture and Storage Institute

- 1) 公众接受度是影响 CCUS 在中国乃至全球得到发展或者部署的重要因素，今天的讨论对于广东的 CCUS 项目有巨大的促进作用，应首先让公众了解这项技术在应对未来气候变化方面能够发挥的作用。
 - 2) 全球碳捕集封存研究院非常重视这项工作，所以我的同事 Jessica Morton，她不远万里从澳大利亚来到广州和我们分享她的经验。
- 1) Public acceptance is having a significant impact on CCUS deployment in China and across the world. Today's discussion will be a big driver for CCUS in Guangdong. We should firstly make sure the public understand the impact of CCUS and the role it can play in climate mitigation.
 - 2) GCCSI attaches great importance to CCUS, and my colleague, Jessica Morton from Australia is to share her experience with us.

05 Peta Ashworth 教授介绍国际项目的公众沟通经验 Peta Ashworth introduces specific experiences of International Communication Projects

- 1) 项目开发过程中，如未能让利益相关者适当参与，技术的采用会存在重大风险。
 - 2) 当风险具有未知的、灾难性和不可控的特点时风险认知尤为重要。遇到不可逆的、可能具有毁灭性的、能立即感知到的、会影响到其他人的风险时认知结果会起到作用。
 - 3) 她以社会因素对于塑造公众对 CCS 认知的作用：美国多州焦点人群访问结果报告为例向大家进行了阐释。对政府、行业和科学管理健康、环境和社会风险的能力缺乏信心可能增加负面的认知，因此，信任和社会环境非常关键。
 - 4) 在程序正义上大家通常会关注几个问题：程序是否公正、透明？是否有人倾听自己的心声？在事件中是否具有发言权？可以向谁寻求帮助？Peta 向大家举了一些例子进行具体阐释，如西澳大利亚、日本的具体项目。
 - 5) 要发挥教育和媒体的作用。
- 1) There is a major risk to the adoption of technology if there is no appropriate engagement with stakeholders during the development process.
 - 2) Perceptions of risk are heightened when the risks are unknown, and might be catastrophic and uncontrollable. The outcome will be strongly affected when the risks are irreversible, potentially devastating, felt immediately, and affect other people.
 - 3) She referred to the publication "The Role of Social Factors in Shaping Public Perceptions of CCS: Results of Multi-State Focus Group Interview in the U.S". Trust and context are critical because a lack of confidence in government, industry and science to manage associated health, environment and social risks is likely to compound negative perceptions.
 - 4) Regarding procedural justice, the public generally focuses on: Will the process be fair? Is it transparent? Will anyone listen to us? Can we have a say in what happens? Whom can I call?
 - 5) Education and the media can contribute a lot.

06 Jessica Morton 女士介绍全球碳捕集
与封存研究院国际项目的公众沟通经验

GCCSI CCS Public Engagement Projects: 2014, by Jessica Morton

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| <p>1) 她首先介绍 GCCSI 是一个国际会员组织，总部在墨尔本，使命是加速全球 CCS 的发展，示范和推广。</p> <p>2) GCCSI 的重要研究出版物是年度全球 CCS 现状报告，这一报告提供了一个完整的全球和区域大型 CCS 项目综合概述，包含 CCS 技术，相关政策，立法和监督环境要素。报告还介绍了在各国家和地区的 CCS 项目，目前的障碍是 CCS 未在大型电厂项目中得到推广，但国际上 3 个新的项目能够提高公众对 CCS 的认知，增强公众信心。</p> <p>3) 2014 年的问卷调查反馈显示出公众参与度对项目推进非常重要，国际协作是关键成功要素，利用项目成功经验提升对 CCS 的教育和理解。</p> <p>4) 基本的结论是：交流不应该被视作项目的附加物。从项目开始就让交流和广大的交流范围成为一体被视作是成功项目的关键要素。</p> | <p>1) GCCSI is an international membership organisation headquartered in Melbourne with a mission to accelerate the development, demonstration and deployment of CCS globally.</p> <p>2) The Global Status of CCS: 2014 is a key Institute publication that provides a comprehensive overview of global and regional developments in large-scale CCS projects, in CCS technologies and in the policy, legal and regulatory environment. The barrier for CCS has been that it has not yet been deployed on a project in the power sector. However, three projects and the ones that follow are going to be vital in improving the public perception of CCS and we can use them to create awareness and build enthusiasm.</p> <p>3) Feedback from the 2014 survey shows that; public engagement is critical for project deployment; collaboration is a key success factor; project success can be used to improve education and understanding.</p> <p>4) A fundamental conclusion is that communication should not be seen as an add-on to the project. Successful projects integrate communication and outreach as a critical component of the project from the beginning.</p> |
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07 主持人林亚茗女士发言：
Comments from Yaming LIN:

在中国，甚至在广州，发生越来越多那种大型的项目因为民众的抵制和不得不搁浅这样的事件以后，媒体对之前的操作模式有一定的反思，之前的沟通总是先从政府开始，但是后来发现民众的力量也不可忽视，尤其是在网络信息混杂的今天，容易对民众产生误导，以致造成很大的负面影响。现在媒体和科学家、媒介公众所做的探索性的工作是非常有利的。同时介绍了南方日报、中英（广东）CCUS 中心以及澳大利亚方合作开展的项目：广东 CCUS 项目公众认知度基线调查。接下来，由南方日报社曹斯女士和大家分享公众认知调查的结果。

In recent years more and more large projects have been delayed, postponed or canceled because of public opinion in China. Communication with the public is important and the media is also critical. Government is an important stakeholder but they are not the only ones. The internet plays an increasing role in the implementation of our projects. In particular when people have a limited understanding or awareness and it is easy for them to get scared by the technology, some will assume that the technology will produce false or distorted impacts. That's why we have cooperated with the UK-China (Guangdong) CCUS Centre and the public in Australia on the Guangdong CCUS Project Baseline Public Perception Survey in Guangdong when the majority of public will have a limited idea of CCS at this stage. In the research, we try to convey the core CCS technology to the public in the simplest way. Ms Si CAO will share the findings of this public survey.

08 南方日报社曹斯女士：
国内媒体在沟通中起到的作用与广东 CCUS 基准线调查结果
以及对公众交流活动的启示

Ms Si CAO from Nanfang Daily described the role of the media in the findings of the Public Communication and Guangdong CCUS Public Baseline Survey and the Implications for Public Communication Work,

1) CCUS 是一项能大规模减少燃煤发电厂温室气体排放量的大型技术，而华润电力（海丰）大型燃煤项目则是首个获广东省政府批准的 CCUS 示范项目。

1)CCUS is a large-scale technology that could achieve deep cuts in greenhouse gas emissions from coal-fired power plants. China Resources Power (CRP) Haifeng, is the first proposed CCUS demonstration project endorsed by the Guangdong provincial government.

2) 鉴于公众认知偏差已成为全球几个大型 CCS 项目的主要障碍，对项目树立社会认可度而言，至关重要 (Ashworth et al, 2012)。

3) 今年8月到9月，南方日报、中英(广东) CCUS 中心以及澳大利亚昆士兰大学合作展开了“关于广东 CCUS 项目公众认知度基线调查，这也是中国首个有关 CCUS 项目网络民调，共有 2410 名公众参与网络问卷。

4) 超过 87% 的利益相关者把“环境污染”这一项标注为“重要”或“非常重要”。将近一半 (49%) 的受访者认为应优先考虑环境保护；10% 的受访者认为即使阻碍经济发展也应优先考虑环境保护。虽然在大型固定排放源已有成熟的技术和程序对硫氧化物和氮氧化物进行控制，但超过 10% 的受访者声称他们没有听说过相关术语。

5) 约三分之二的受访者声称自己没有听说过 CCS 这项技术。相比之下，发达国家民众对该项技术的认知程度更高。

6) 利益相关者被问及他们对广东华润电力(海丰)大型燃煤项目的了解程度。60% 的受访者表示“没有听说过”这个项目；而在听说过此项目的人中，表示了解该项目采用了硫氧化物去除技术和二氧化碳捕集技术的人数分占 29% 和 42%。

支持以及强烈支持 CCUS 项目的人数占 45%，稍微支持的占 14%，持中立态度的占 29%，12% 的被访者表示反对这个项目。因此，过半数受访者支持该项目。

2) As public perception has become a key barrier for a few major CCS projects in the world, building social acceptance for a specific project is critical for demonstrating CCS technologies.

3) The study was commissioned by the UK-China (Guangdong) CCUS Centre to gather baseline information for designing a CCUS public communication and stakeholder engagement program for the CCUS demonstration project in Guangdong province. It is also the first CCUS Project Baseline Public Perception Survey in China and was completed by 2,410 participants in August 2014.

4) When asked to rate the priority issues for the local community, more than 87% of public stakeholders ranked the environment as either important or very important. Approximately half of the respondents (49%) considered that protecting the environment should be a priority, but only 10% of all respondents believed environmental protection should be prioritised, even though it might hinder economic development. Although there have been mature technologies and processes applied to large stationary emission sources for SOx and NOx control, more than 10% of public respondents recognized the emission control processes.

5) Approximately, two thirds of respondents claimed they had not heard of CCUS technology. This level of awareness was lower than in developed countries.

6) In the final part of the survey, stakeholders were asked about their awareness of the coal-fired power plant where a specific CCUS demonstration project in Guangdong, the CRP (Haifeng) CCUS project, will be hosted. A majority (60%) said they had not heard of the project. Of those that had heard of the project, 29% claimed they knew the project has adopted the SOx removal technology, while 42% indicated it would adopt CO2 capture technologies.

7) 45% of the participants showed strong support to CRP Haifeng CCUS project, 14% were supportive, 29% neutral, and only 12% opposed this project. In conclusion, more than half of the respondents were supportive of this project.



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主持人林亚茗女士：
Comments from Yaming LIN:

在完成调查后有两种心情：一种是沮丧，因为社会上对 CCS，包括环保项目了解很少；另一方面又有信心，基于此，媒体、专家、专业工作者、企业会有更多的工作去做，让更多的人了解，就是进步。

The research findings are firstly depressing because few people know about CCUS. However, on the other hand, poor knowledge among the public means the media, experts, enterprises have a lot to do to educate the public and get more and more people to understand CCUS.

10 圆桌讨论：新形势下项目开发商与公众的沟通形式，朱和平先生主持
Round table discussion: Effective models to communicate between developers and the public in the new era, chaired by Heping ZHU

1) 主持人朱和平
Chaired by Heping ZHU

- 华润电力的项目背景：华润电力投资在广东省汕尾市海丰县小漠镇建设的两台 100 万的千瓦燃煤发电机组，总投资是 83 亿人民币，项目从 2008 年启动，2011 年获得国家发展和改革委员会核准，预计 2015 年 2 月首台机组正式发电。
- 在中英（广东）CCUS 中心的支持下，我们现在在 CCUS 前期的开发工作，准备分三个步骤来做，第一，在我们目前计量观察的基础上，要做多技术的小径测平台，目的是为了筛选更先进合理的 CCUS 技术，作为量产的发展；第二步，我们准备在 3 号和 4 号机组开展百万吨级别的示范项目。
- 仅从华润电力海丰项目 1 号和 2 号机组每年二氧化碳排放量接近 1000 万吨，而去年全国二氧化碳的捕集仅 20 万吨，所以说我国的温室气体减排任重而道远。我认为项目开发与公共沟通都是非常重要的。
- Background to the CRP Haifeng Power Plant CCUS Demo Project: 2 x 1 MW ultra-supercritical coal turbines built by CRP and was approved by the states in 2011 and the first turbine is expected to operate in February 2015.
- Three steps for the project: firstly, when the turbine is launched into production it will constitute a testing platform for different technologies and the most advanced CCS technologies will be identified and applied; secondly, a medium scale project will be built; finally, full scale capture will be carried out on turbines 3 & 4.
- 10 million tonne CO2 emitted from one single project into the air every year, yet only 200,000 tonnes of them are captured in China. We have a lot to do in terms of emissions reduction.
- A proper way must be found to communicate with the public to solve the need for project development.

2) 在网络媒体上较为活跃的 A 专家首先进行发言：
Expert A - who is active on social media:

“

一直以来对环境事业都比较关注，也做了很多与环境相关的实践，其从一下三个方面谈了自身的一个看法和体验：

I am always concerned about the environmental issues and have participated in lots of environmental projects.

”

- 透明：主要包括政府，司法，媒体，项目资讯的沟通透明，澳大利亚等国外问题不大，但在国内，司法、政府媒体资讯传递公信力受到质疑。
- 信息沟通方面：主要指的是项目资讯与媒体的沟通，媒体是项目方经过筛选后的官方传递渠道，其主要传递的都是正面信息，极少有负面信息，这也成为居民参与反对项目的主要原因。相比之下，国外媒介主要是一个辅助作用，但在国内，媒体成为公众知晓信息的主要渠道甚至是唯一渠道。各种信息不透明不对称，造成网络信息与传统媒体信息的巨大不同，使得网络成为促成为反对类似项目的巨大民意动员工具，进而造成了自身的混乱。
- All of you mentioned the key word “transparency” over government, public media or project transparency. These are not a big deal in Australia and other countries. However, the credibility of the judiciary, the government, and the media have been doubted.
- Communication of information: newspapers and the new media of the internet should work in collaboration, not in opposition. Media is the sole information source for the public in China. While information asymmetry exists, in many cases the public may know little about the negative impact of those projects.

■ 最重要一点，利益：不仅仅来自项目方面，还来自其他方面，如政府政绩，房地产商的利益进行干扰。澳大利亚专家介绍其政府注重充分沟通，不以项目的倒计时为主要的刻度，在中国，政府控制舆论，甚至选择性的传播舆论，第二个则是加快工程建设，通过强烈的政治维稳手段，推动项目进展，造成民众更强烈反抗，在大型化工项目，环保项目，落户在自身的居住区时，民众选择对自身健康和财产的维护一般会选择两种方式：

- 1、奋力抗争，与政府对着干，让执政者感受到压力。
- 2、卖了房子走人。在第二个层面上如果加入大型房地产因素推波助澜的话，往往会起到强有力的动员作用。人们更多的关注房价是否会受到项目的影响，而其中的利益决定了其抗争的力度。

3) 项目开发者发言：
Project Developer:

“

作为实际执行项目的企业家在执行过程中的切身感受：
Mr. Zhu shared some experiences during project development:

”

信任是第一位的，即开发商、政府和公众之间相互信任。国家项目开展过程中要求公众参与度的百分数，在企业寻求民众进行许可签字时，会出现带有中国特色的一幕：一部分人提出

■ The different interests of business, government and the public need to be coordinated. In some projects like PX projects, real estate developers will do all sorts of things to advance their own interests. Personal standing is very different and useful in communication. The level of impact on personal interest determines the degree of public pressure towards a project.

Trust between project developer, the public, and the government is of vital importance to guarantee the smooth implementation of major projects.

When we develop a project in China, it is usually the case that those residents with an

了给四十万然后就给签字这样的要求。这就直接影响了项目的直接进展，信任包括互相的良性信任，通过对百姓的调查发现，在推动项目进行时，最主要的并不是对于企业的矛盾，而是百姓与政府自来有矛盾，只要是政府发动便反对，当然这只是一个作为一个机械的案例存在。在我国，公关参与事件的方法问题掌握不好，好事很容易办成坏事，在处理相关事情时要结合国情，有时候政府反对的并不是单纯这个事情，而是一直反对政府。

4) 中国社会科学院社会学研究专家 B 发言：
Expert B from Chinese Academy of Social Sciences:

- 其首先提出了在面临化工业或是矿业这一类的项目时都存在一种邻避效应，要在全国范围内建这样的项目大家普遍没意见，但是当这个项目建设到自己的城市时便会受到一定的反对。
- 有三个变量影响到公众对于项目开展的信任程度，其中包括 1、利益：主要包括补偿问题及补偿的公平性问题 2、社区参与感 3、政府对项目的监管。其对澳大利亚、智利、南非的这个信任影响因素进行了一个对比，结果发现，对中国来说利益的分配方式是最为重要的影响因素，在其他国家则相对来说较为均衡。
- 就现在来说，在项目实施过程中，一直存在社区参与感低的情况。除此之外另一个因素是政府的监管，在中国来说，政府和企业一般都是站在一起的，我们面临的是这样一种双边关系，如果说这种双边关系处理不好便会成为对立关系。这也是中国整个环境下所遇到的同国外完全不同的一个现象。

interest will charge a great deal of money in order to induce them to sign their public approval of the proposal, yet they know little about the progress and potential impact of the project. At the same time, the public has already lost faith in the government. So, the project developer and government must adopt a proper way to win trust from the public, especially from local residents.

- “Not in my back yard” issues exist widely in the development of mining and petrochemical projects.
- The three important variables that affect the public’s trust in projects are: 1. Interest, including compensation, and the fairness associated with it; 2. Community participation and its impact; 3.Regulation from the government. A comparative study has been carried out on these variables, and it was found that a profit-sharing arrangement is the most important factor in China, while the above three factors also have the same influence in other countries.
- The status of community engagement: there is a low level of public involvement and engagement in the execution of certain projects. People think that their participation will not make a big difference. Sometimes the government has a close relationship with industry, and they are on the same side. It is also essential to construct a virtuous relationship between the public and government-industry.



5) 暨南大学教师 C:
Teacher C from Jinan University:

- 公众接触这些项目信息最直接最普遍的方式源于百度百科和维基百科，这也是普通老百姓获取信息的一个重要渠道，其作为一个信息斗争的场所需要引起人们的重视，如果说这种项目是安全的，那么你就需要提供详细的资料去论证百度百科和维基百科的内容，不要让民众从这些百科中获得对于这类项目不安全不属实的负面评价。
- 你需要明确的告诉老百姓这个东西到底存在什么危害，泄露之后会带来具体的什么影响，民众更多关心的是与自身利益相关的事情，当然在沟通过程中还需要把文化的因素考虑在内，注意话语风格的不同，在沟通过程中需要考虑到其中存在的文化差距。
- 还有一个是公信力的问题，现如今出现的一个问题是公众对于政府的信任度较低，同样整个社会对于企业、公关公司和专家都存在一定的不信任，这个时候为了达到信息的有效到达，便要着重寻找更有利于沟通的第三方，可以寻找更值得公众信任的意见领袖或是采取同伴教育的方式。
- Wikipedia and Baidupedia become the general source of knowledge for the public. Therefore, we should provide detailed information on these websites to popularize the technology and avoid the spreading of false information.
- The public should be well informed of the potential impact or damage of leakage, because for them the important factors are the negative impact or benefits they can get from this deed. We should also adopt the proper way to communicate such information in a positive manner, taking into consideration the cultural factors.
- The general public's lack of trust in government, enterprises, public relations and sometimes the experts are important factors. In this case, a third party, trusted by all parties, can be introduced to communicate with existing parties.

6) 在网络媒体上较为活跃的 A 专家跟大家分享了与核电厂有关的，发生在浙江温州的一个案例：
Expert A related a case relating to a nuclear project in Wenzhou, Zhejiang:

“

为了建电厂，当地村长在此征地，在这个过程中造成了部分村民的死亡，而引起了互联网的一个舆论大讨论。

Some villagers died in the conflict between government and the local villagers over the land acquired for the constructing of the power plants.

”

- 政府在网络上完全失去话语权
- 企业成为了被攻击的靶子
- 公民观察团、网民围观团、专家调查团三者在当地开始争夺话语权
- 网络大 V 调查团进村调查后，政府在这个过程中没有话语权的，村民与政府存在着某种土地利益的抗争，其向调查团所提供的信息都是利于自身的，但其所提供的信息并不是完全真实的。
- The local government completely losing credibility.
- Local enterprises becoming a target for opinions on the Internet.
- Conflict among the public, internet and investigating experts to lead the public opinion. There was a serious confrontation between local government and the villagers. The villagers, in their own interests, only provided information that was beneficial to themselves and not entirely truthful.

7) A 专家发言:

Expert A:

“
怎么看待社交网络与公关媒体影响力的关系?
What is the relationship between the social and public media?
”

- 社交媒体改变了中国人的整个话语生态，大家在这里分享信息，在这里形成了无组织的组织、无政治的政治、无权利的权利和无劳动的劳动。我们的互联网成为了一个民意表达、集散甚至是抗争的渠道。在移动互联网和智能手机的普及之后，中国有将近 7 亿人在使用移动媒体，当一件事情关乎自身利益时候，大家便会活跃表达。
- Social media has become an important portal for people to exchange their opinions; it is a bottom-up channel for changing opinions. Because of the popularization of smart phones, nearly 700 million people in China express their opinions freely on the Internet. And these “netizens” are especially active when their interests are closely related to a public event.
- 在这里形成了最主要的权利，而且这种权利是无法自上而下进行固化的，它是一种自下而上的赋权行为，故而形成了意见领袖和大 V。
- Bottom-up empowerment is happening here, producing opinion leaders which can change frequently.

8) 领事馆 D 代表发言:

Expert D:

- 首先从较泛的一个角度对此进行了思考：从 B 老师之前所提到的邻避效应想到，每个人都是自私的，人性本身就存在恶的一方面，在处理各方面利益关系的过程中，是否可以出台一种政策来实际的处理这种均衡利益的问题。
- To think of this from a more general perspective, regarding the “not in my back yard” attitude, human nature is selfish, and is it possible to adopt and implement policies to address the distribution of benefits.

- 二氧化碳的减排技术及 CCUS 技术来说，我们首先应该对此进行去妖魔化，它本身是一种无毒无害的气体，对于人世无害的，结合具体的 CCUS 项目，在遇到阻力时应该思考如何将这种阻力转化为一种动力，在我国在碳交易机制上有了一定的成果，为了减排低碳存在这样的一种超出碳排放额度便需再交费用，是否可以考虑将这种类似的机制引入 CCUS 项目中，生产面向个人的碳金融产品，并允许社区中的公众将自身未使用完的碳额度带到市场上进行交易。花时间去建设有些虚无缥缈的公信力，还不如实实在在的去思考这样一种良好的利益分配机制的建立，利益面前，大家都是公平的。
- For CO2 emission reduction and CCUS technologies, we should firstly de-demonize CO2 which is innocuous and not poisonous. When we are confronted with challenges from the public, we should consider how to convert this to an opportunity. In China, carbon trading schemes have been established and developed; we could also consider a personal emission allowance system which will allow people to trade their extra allowances in the market.

9) 主持人朱和平先生发言:

Mr Heping ZHU:

“
开发商与公众沟通上存在的问题：如何有效实现目标；利益相关人利益是根本问题；沟通的方式方法问题。
Three issues exist in the communication between project developers and public: how to effectively accomplish the goal; how to address the interests of stakeholders; and the means of communication.
”

10) A 专家:
Expert A:

“

哪个群体的声音更有公信力，公众更愿意相信谁？
Which party would the public prefer to trust in?

”

- 公众会首先去寻求他们自身希望想要获得的资讯，他们的观念也是基于自身利益进行选择。
- 政府在进行决策过程中都会有很多铺排工作，这也是一个教育公众的过程，现在普通公众获取资讯的方式更多来源于微信朋友圈，我们已经进入全民浅阅读的时代，现在需要社会工作者更多的进行面对面的交流，回到 CCUS 项目的一个沟通问题上，A 专家提出可以用一种公众更能切身体验的一个亲切的方式与其进行交流，譬如借助有趣的传单和漫画人物这样的载体上面。其认为更多的不是公众更愿意相信那个群体或机构的问题，更多的还是采取何种沟通方式的问题。
- 网络上来说，在信息传播过程中，不允许任何个人或机构做英雄，民众从被动接受信息到主动寻找再到消极接受信息。任何机构或个人都不允许去做这样的沟通工作，而存在摩擦时，谁能取得公众更多的信任这可以说是一个无解的问题，更多的时候除了政府，只能是政府自己。

- The public themselves choose the way in which they acquire information.
Most people get their news through SMS rather than conventional services. In the new media age, people need lots of face to face communication. For CCS, we need to ensure stakeholders and the general public have hands-on experience on what might affect them.
- The government does not allow any individual to be a hero on the Internet. The public has been transformed from a passive to positive mode in terms of searching for and acquiring information. It is difficult to find an answer as to which is the most reliable source of information.
- When confronted with specific issues, the public still prefer to trust the government.

10) 梁希教授总结:
Conclusion by Prof Xi LIANG:

“

在学界、企业操作层面有这样一个沟通的机会很难得，并对与会嘉宾和学者到场交流表示感谢，并就这一课题发表了相关看法：
He expressed his appreciation to all the speakers and guests, and concluded that:

”

- 本课题对推动 CCUS 项目的示范包括商业、融资以及与公众沟通模式的示范有很好的促进作用。
- 今天也对如何构建项目业主与公众沟通好的模式进行了讨论，我们所开展的这些项目可能确实会带来相关问题，但其对经济发展的推动作用是非常大的，在推行这些项目时，在于公众沟通的问题上有大量的工作要做，希望大家以后对此话题进行多沟通。
- Public Communication is of great importance to facilitate the demonstration of CCUS business, finance and public communication models.
- Those projects we are developing may bring some problems, yet they can also bring great economic growth. We have discussed how project developers can effectively communicate with the public, and we still need to do a lot regarding this issue.

广东省汕尾市海丰县小漠镇学校交流活动

Communication activities in school in Xiaomo County (where the CRP Haifeng Power Plant CCUS Demonstration Project is constructed), Haifeng, Shanwei, Guangdong

场地：广东省汕尾市海丰县小漠镇
Venue: Haifeng, Shanwei, Guangdong
日期：2014年12月12日
Date: 12 Dec, 2014



12月12日上午，在小漠镇小学的六年级和中学的初一，来自澳大利亚、美国和英国7位专家先后为孩子们上了生动的能源和环保的科普课。生动的文字和图片资料发到每人手里，然后又有简易的示范操作。汽球、汽水都成了道具，每张课桌的两个学生结成实验拍档，跟着专家的讲解一步步操作。他们从中学到了电是如何产生的，二氧化碳是什么，会产生什么结果，又是如何被收集和储存。

兴奋不已的学生们，最后得到了专家赠送的澳大利亚小玩具，以及一张科普学生合格证书。老师们也高兴地看到学生在英语和科普方面的收获，而这些不远万里来到中国乡镇学校的洋专家也同样深受鼓舞。PETA女士说：“中国的孩子很聪明好学，乐意接受新知识。我们希望以后还会来。”

On the morning of December 12, seven experts from Australia, America and the UK successively gave lively science lessons on energy and environmental protection for children in Grades 6 and 7. Lively words and pictures were handed out to everyone and then there was a simple demonstration. With balloons and soda water as props, two students at each desk became partners in the experiment, following the experts' instruction step by step, from which they learned how electricity is produced and what carbon dioxide is, what effects it has and how it is captured and stored.

Excited students were later rewarded with Australian toys from experts and certificates for their efforts to popularize science. In the meantime, teachers were delighted to see what the students gained in knowledge of English and science, while the foreign experts who came to schools in Chinese towns thought the long trip was also greatly encouraging. Mrs. PETA said, "Kids in China who are very smart and fond of study are willing to accept new knowledge."



镇长谭梅唇说：“小漠是海丰最小的镇，能够争取到华润来落户是荣幸。但同时，小漠是海丰自然环境最好的地方，群众主要以捕鱼以及养殖虾蟹为生，因此对环境的变化特别关心。华润电厂本着对小漠人民负责的态度，多花了2亿元来增加环保设备，这让我们看到了他们的诚意。但这个沟通工作不是一劳永逸的事，尤其在电厂投产后还有更多工作要做。我建议，将来要分批地邀请群众去参观电厂，特别是环保设施的运作。比如渔民可能关心对水质的影响，就要请他们看看水质处理情况。一般百姓关心空气，也请他们看看空气的净化情况。为了不影响电厂的生产，电厂可以设立专门的科普日，并建立一个简易的科普中心，介绍如何发电以及环保的原理和现状，同时回答有关的疑问，让大家真正地放心。”

Mayor Meichun TAN said, "As the smallest town in Haifeng County, Xiaomo is honored to be the location of the China Resources Power Plant. But at the same time, people in Xiaomo, which has the best natural environment in Haifeng, mainly live on fishing as well as breeding shrimps and crabs, so they care particularly about environmental changes. Acting responsibly for the people in Xiaomo, the China Resources Power Plant spent an extra 200 million yuan to install environmental protection equipment, which shows their sincerity. However, the communication work cannot be done all at once, and more work needs to be done especially once the plant is operational. I suggest that people should, group by group, be invited to visit the plant, particularly to view the operation of the environmental protection equipment. For example, fishermen may care about its effects on quality of water, thus it is necessary to invite them to see the quality of the water treatment. People generally care for air quality, so they can be invited to look at air purification. In

华润海丰电厂的李义总说：“20年前，当我们引进脱硫等环保技术时，一是觉得新，似乎离我们很远；二是觉得贵，大大增加成本。然而，这个以及后来更多的环保技术不但在行业普及了，成本也降下来了，而且成为行业的准入门坎。因此，我相信碳捕集与封存技术也将是如此，我们迟早要走这条路。早走的话，不仅能够得到国家有关部门的重视，也为企业积累了经验和声誉。所以，我们会支持，会走下去。”

order not to disrupt electricity production, the plant can set aside a specific day to popularize science, to explain how electricity is generated and the theory of environmental protection and its status. At the same time related questions could be answered through the creation of a center for science popularization so that everyone can actually be reassured."

Mr. Li from China Resources Power Haifeng Plant said, "Twenty years ago when we introduced such environmental technologies as desulfurization, we thought the new technology seemed to be far away and at the same time its high cost significantly increased costs. But this technology and

later more environmental technologies have become popular in the industry, and the norm in certain industry, as the costs dropped. As a result, I believe that CCS will be also like this, and that we will follow this path sooner or later. If we are an early mover, not only will we obtain the attention of related departments, but also accumulate experience and reputation. It therefore has our support."



中英（广东）CCUS 中心 碳市场兼容性研究座谈会纪要

UK-China (Guangdong) CCUS Centre Carbon Market
Compatibility Research Roundtable Meeting

场地：广东省东莞市松山湖银丰逸居酒店攻略室
Venue: Dongguan Silver World Hotel & Resorts,
Dongguan, Guangdong
时间：2014 年 12 月 13 日 16:00-18:00
Time: 16:00-18:00 on December 13, 2014



参会人员 PARTICIPANTS

Peta Ashworth, Ash 咨询公司
Peta Ashworth, Ash Research

何为之, 英国驻广州总领事馆能源与气候变化处
Weizhi HE, Department of Energy and Climate Change of British Consulate General
to Guangzhou

尹主任, 黄主任, 东莞清溪镇低碳城镇化建设项目办
Director YIN and Director HUANG from Low-carbon Urbanization Construction Project Office of
Qingxi, Dongguan

梁希, 中英（广东）CCUS 中心
Xi LIANG, Secretary General of UK-China (Guangdong) CCUS Centre

王岚, 爱丁堡大学
Lan WANG, the University of Edinburgh

聂兵, 中国赛宝认证中心气候与能源部主任
Bing NIE, CEPREI's Climate and Energy Director

曾雪兰, 中山大学
Xuelan ZENG, Sun Yat-Sen University

乔峰, 暨南大学
Feng QIAO, Ji'nan University

傅京燕, 暨南大学
Jingyan Fu, Ji'nan University

李原, 暨南大学
Yuan LI, Ji'nan University

李善军, 康奈尔大学
Shanjun LI, Cornell University

会议进程 PROCEEDINGS

梁希博士首先宣布会议开始, 并介绍参会嘉宾, 说明本次会议的目的是为英领馆 SPF 碳市场链接项目的后续工作制定方向, 探讨广东未来在国际碳市场的定位。

Opening the meeting and introducing participants, Dr.Xi LIANG made it clear that the aim of this event was to determine directions for follow-up work in respect of the British Consulate General's project to link Guangdong's SPF carbon market and to discuss the position of Guangdong in the future international carbon market.

01 王岚介绍项目中期报告——欧盟和广东的碳市场兼容性 Interim Report of the compatibility of the EU-Guangdong ETS Linkage Study

1) 研究背景 Background

- 欧盟和广东碳排放权交易体系链接的经济效益: 排放权交易体系的链接能提高市场效率, 降低减排的总成本, 扩大市场规模, 提高市场流动性, 并为市场参与者提供更多的减排方案。
- Economics Benefits of linking the EU and Guangdong ETSs: Linking ETSs can enhance market efficiency, reduce the overall cost of mitigation, increase the scale of the market, improve market liquidity, and provide participants wider mitigation options.

■ 欧盟和广东排放权交易体系链接的政治和商业效益：减少可能的碳泄漏，改善一个不成熟的碳市场的监管、设计和运作；通过促进中国和东南亚国家的链接鼓励南-南地区在碳定价系统方面的知识共享；英国政府还可以鼓励国内金融服务业与研究机构合作来实现与新兴碳市场的间接链接。

■ Political and Commercial Benefits: Linking individual emission trading schemes can also reduce the potential for carbon leakage, and improve the regulation, design and operation of a less mature carbon market. It is also beneficial to encourage South-South knowledge sharing in establishing a carbon pricing system, through promoting links between China and Southeast Asia Economies. The UK government may also encourage the domestic financial service industry to collaborate with institutions to achieve indirect linkage (e.g. financial linkage through innovative derivatives with emerging carbon markets to accumulate business development experience).

2) 潜在链接模型 Background

- 直接链接：单边链接（单边链接是一种单方面链接，为了履约，广东限额交易机制允许覆盖的实体交出欧洲排放配额就是一种单方面链接），双边链接（双边链接允许参与者在欧盟和广东购买相互购买配额用于国内遵从），分级链接（增加的匹配限额交易方案的关键要素被称为等级链接）；
- 间接链接：京都议定书，金融市场（交换模型）。
- Direct Linkage: Unilateral (Unilateral linkage is a one-way link, under which the Guangdong cap-and-trade mechanism allows covered entities to surrender EUA (European Allowances) for the purpose of compliance); Bilateral (Bilateral linkage allows participants in the EU and Guangdong to purchase allowances from each other for domestic compliance); Linkage with Degrees (Incremental aligning of key elements in the cap-and-trade programmes).
- Indirect Linkage: Kyoto Protocol, Financial Market (SWAP Model).

3) 链接的障碍 Barrier to Linkage

- 链接前高价体系中的卖方将以较低的价格卖出配额而相应的买方将不得以较高的价格购入配额；
- 链接系统的政府可能会失去对其排放权交易体系的设计和监管的控制；
- 链接中较大的市场倾向于对碳排放权的价格有更大的影响力。
- Similar to an international trading agreement, sellers in the pre-linkage higher-priced system will receive a lower price for the allowances while the buyer in the pre-linkage low-price system will have to pay a higher price for the allowances.
- The governments of the linked system may lose the control of the design and regulation of its own ETS
- The larger system resulting from the linkage is likely to have a greater influence on the carbon allowance price.

02

聂兵演讲：广东省碳市场未来的可能演变
Future Possible Changes to the carbon market in Guangdong by Bing NIE

1) 我相信在座的各位达成的共识是，碳市场是具有前景的。

1) I believe that every participant here thinks that the carbon market is promising.

2) 碳市场的发展路线是：CDM-CER-VER-成熟市场-碳金融、碳资本市场。就碳交易来说，成交量湖北最多，全国不尽如人意，广东市场的潜力大；价格方面持续走低，上一次交易仅20.67元；交易总额未达预期；政策压力成为交易的主要动力。

2) Developing a Roadmap for a carbon market is CDM-CER-VER-Mature market-Carbon Financial and asset market. In terms of carbon trading, despite the fact that trading has not performed well across China, Hubei Province has the largest trading volume, and there is great potential in the Guangdong market. Meanwhile, with the continuous low carbon price, trading volumes just reached 20.67 yuan during the last period, so trading volumes did not reach expected levels. Policy pressures have a major influence on trading.

3) 碳交易与碳资产

a. 碳交易模式:

传统来说有三种: 京都议定书; 自愿性交易; 总量控制交易; 未来希望能开发出基于正向激励的交易模式。

b. 碳资产形式:

企业; 个人; 碳市场的延伸 (增加流通资产, 对市场实施政策引导和价格鼓励, 开发新的市场模式和金融产品)

c. 普惠制的实现方式:

- 将个人与小微企业的节能减排行为量化, 进行统计;
- 碳交易所通过现金及其它奖励方式激励交易;
- 政策激励, 例如节能减排政策: 用社会公众和小微企业的低碳行为抵消排放, 实现普惠, 促进公众节能减排。

4) 需要加强低碳产品认证

5) 建立一个广义的低碳产业: 即将低碳内涵赋予到社区、学校、工业园区、金融、物流、林业、农业、旅游文化、交通建筑等领域, 实现低碳市场的延伸, 构建一个庞大的产业体系。

3) Carbon trading and assets

a. Carbon trading models

Traditionally, there are three models, including the Kyoto Protocol, voluntary trading and the cap-and-trade model. Trading models are expected to be developed based on positive incentives.

b. Forms of carbon assets

Businesses, individuals and extension of carbon market (improve asset liquidity, and provide policy guidance and market incentive, develop new market-oriented models and financial products)

c. Implementation models of GSP

- The energy savings and emission reductions of small and micro- enterprises need to be quantified
- Carbon exchanges stimulate trading by means of cash and other incentives
- Policy incentives such as those on energy saving and emission reduction: in particular incentivise low-carbon actions within the public community and small and micro-enterprises so as to facilitate the public to save energy and reduce emissions

4) Certification of low-carbon products should be strengthened.

5) Building a low-carbon industry in a generalized sense, means that low-carbon technology should be distributed into areas such as the community, schools, industrial parks, financial sector, logistics, forestry, agriculture, tourism and culture, transportation and construction, and the low-carbon market extended so as to form part of the larger industrial system.

03

曾雪兰: 广东 - 深圳碳市场衔接研究 / 广东碳市场发展状况

Research on the linkage of Guangdong-Shenzhen Carbon Market/ Development of Carbon Market in Guangdong

- 广东与其他地区的碳市场连接即利益的重新分配, 在具体操作和技术上仍面临一些问题, 而最大的障碍是经济利益问题。
- 技术层面的研究包括两个方面: 一是机制, 对 MRV、报告检查、配额分配、总量和交易的差异的研究以及解决方案; 二是具体操作方案, 即信息和交易系统的链接。
- 目前对政治、经济利益的分析还不够深入。
- 由于地区接近性, 广东 - 深圳碳市场链接比欧盟 - 广东碳市场链接更可行, 而且广东 - 深圳的链接也为全国性碳市场的建立奠定实验基础。
- 分阶段链接是目前可行的方法。广东和深圳的碳市场在配额分配上的松紧度有一定差异, 但影响不大; 而在配额互认上, 研究认为 1:1 的比例是最可行的。
- In linking the carbon market of Guangdong to others, benefits should also be redistributed. There are some problems in the specific operations and technology, among which the issue of economic benefits is the biggest barrier.
- Research at the technological level include: (i) mechanisms, including research on MRV, inspection reports, the differences in distribution of allowance, allowance volumes and trading volumes as well as solutions; (ii) specific operating programs, i.e. the link between information and trading system.
- So far, the analysis on political and economic benefits is not deep enough.
- Owing to the fact that they are adjacent to each other, it is more feasible to link the Guangdong and Shenzhen carbon markets than to attempt to link those of the EU and Guangdong, and moreover, the link between the Guangdong and Shenzhen carbon markets provides an experimental basis for the construction of a national carbon market.
- One potentially feasible way is to carry out the link in phases. The slight differences in distributed allowance quotas between the carbon markets of Guangdong Shenzhen have little effect. As for the mutual recognition of allowances, research suggests that a ratio of 1:1 is most feasible.

04

圆桌讨论（乔峰主持）

Roundtable Discussion held by Feng QIAO

李善军教授发言：碳市场的链接能降低减排成本，但污染在各地带来的影响程度不一致，即各地的社会成本和减排成本存在差异，如果这种差异小，那就应当加快链接，如果差异较大，那链接可能适得其反。另外，欢迎各位嘉宾积极向《Resource, Energy, Economics》杂志投稿。

主持人乔峰提问：广东 - 欧盟碳市场链接能为中国与国际碳市场链接提供哪些经验？

李原答：首先，我觉得中期报告中缺少对欧盟和广东两个市场的研究。可以看到，国内的碳市场操作过程中存在一些问题：国内市场的监管体系与欧盟存在差距；中国碳市场的成熟度还不够，市场结构包括参与者结构都不完善，中间机构缺乏，现货市场对冲风险的能力较弱；企业缺乏交易策略，交易意愿低，因此，在设计碳市场时应考虑参与者的接受能力，实现交易搭配，让市场参与者实现意愿，达到风险可控。

主持人乔峰：市场差异确实存在，链接时要重点考虑这个问题。

聂兵发言：中国和欧盟的碳市场链接的重点是金融和技术链接，应让市场特性、市场吸引力成为链接的主要驱动力。

Prof Shanjun LI: Linking carbon markets can reduce the costs of cutting emissions, but the degree of pollution differs from area to area, which means that there are gaps in social costs and the cost of emission cuts among various regions. If the gap is small, the linkage should be accelerated; but if the gap is large, the effects of the linkage are likely to be opposite to those expected. In addition, any contribution to Resource, Energy, Economics is welcomed.

Q (from Feng QIAO): How would the link between the Guangdong-EU carbon markets affect a possible linkage between the Chinese and international carbon markets?

A (from Yuan LI): First, I think that the interim report lacks sufficient research on the EU and Guangdong markets. It can be seen that there are some problems in the operation of the domestic carbon market: there exist gaps between the domestic and EU market regulatory system; with an immature domestic carbon market, market and participant structures are not sound; the domestic market lacks intermediary agencies, and has a weak ability to hedge against risks in the spot market; with little willingness to trade, enterprises lack trading strategies. As a result, in designing a carbon market, the acceptability of participants should be taken in account and matched trades should be booked so that participants willingly enter into transactions confident that the risks can be controlled.

Feng QIAO: Differences between markets do exist, so this issue needs to be particularly considered during the linkage.

东莞市清溪镇代表尹主任：东莞市清溪镇建设低碳生态小镇的项目目前正在探索阶段，希望建立一个发展框架，先让企业参与，再以点带面，在交通等方面让低碳融入生活，将来还会与深圳坪山低碳城对接，低碳发展之路任重道远。

傅京燕发言：碳市场链接适合做大区域管理，考虑边际减排成本和总量控制的设置。碳交易覆盖的行业有限，短期内效果不如碳税，对于“碳交易更适合未来碳减排”的论证很重要。

梁希总结：碳市场链接的经济、政治利益是重要关注点，短期内适合采用间接链接以及利用金融工具的方式，长期来看还有更多的问题值得研究，包括碳排放权交易的价格设置，是否可以先将 CCUS 纳入广东碳交易机制，再将其纳入全国碳市场机制，以及如何将拍卖所得利用到清洁绿色发展当中；中期报告中需要增加对欧盟和广东两个市场的研究；另外低碳城镇试点也很有意义，可为普惠的发展奠定基础。

Bing NIE: The focus of linking the China carbon market to that of the EU is financial and technological, and market characteristics and market attractiveness should be main driving forces for linkage.

Director Yin as representative of Qingxi Town, Dongguan: the project to construct a low-carbon ecological town in Qingxi, Dongguan is at the exploratory stage for the purpose of creating a development framework, under which enterprises participate first and then low-carbon is progressively integrated into daily life through such aspects as transportation. It is hoped that a linkage with the low-carbon town of Pingshan, Shenzhen will be achieved in the future. The challenging path to low-carbon development has a long way to go.

Jingyan FU: The linkage of carbon market is adapted for management in a large area, considering the marginal emission reduction costs and volume control. Owing to the limited number of industries covered by carbon trading and the unfavorable short-term effects of a carbon tax, the argument that on “carbon trading is more suitable for future carbon emission reductions” is very significant.

Xi LIANG's summary: The economic and political benefits of linking carbon markets have become major focuses. In the short term it might be appropriate to adopt a way of indirect linkage along with the use of financial instruments. In the long term, some more questions are worth studying, including setting prices for carbon emission permit trading, the question whether to integrate CCUS into the carbon mechanism of Guangdong and subsequently the national carbon market mechanism, and the problem of how to apply the revenues from auctions to clean green development. The interim report shows the need to increase studies on the EU and Guangdong markets. Furthermore, low-carbon pilot cities and towns are significant, which can lay a foundation for GSP.

近零排放：重要新闻回顾

NZE: Important News Digest

2014年9月至11月

May to August, 2014



民调显示 87.7% 的网民不反对建设 CCS 项目 (01/09/2014)：支持建设的网民占 58.95%，有 28.77% 的网民持中立态度。9 月 1 日，广东 CCUS 项目网络民调结果出炉。2400 余名公众通过填答网络问卷，对广东正在筹备的国内首个海上碳捕集、利用和封存 (CCUS) 示范项目表达了看法，超过 87% 的网民表示不反对建设该项目。这也是国内首次就 CCUS 进行的大型公众网络调查。

参与调查的公众中有约 85% 居住在广东省。调查结果显示，有 58.95% 的网民对广东省汕尾市海丰县计划建设的海上碳捕集、利用与封存示范项目表示支持，持中立态度者占 28.77%，另有 12.33% 的网民仍对该项目存疑。

有约四成的受访者在调查中表示，对 CCUS 项目运用了硫化物去除、悬浮微粒去除、净水处理、二氧化碳去除等污染控制技术表示知晓。34.25% 的网民对该技术项目的整体运作有较多了解。(来源：领先财纳)

A Survey Shows that 87.7% of Netizens are not Against CCUS Construction (01/09/2014): An online survey on CCUS in Guangdong, which is also the first large-scale public online survey on CCUS in China, has come

58.95% of netizens support for CCUS construction, while 28.7% of netizens hold a neutral attitude towards it. Through filling in a questionnaire online, more than 2400 netizens have expressed their opinions on the first CCUS demonstration at sea that is planning to be constructed in Guangdong, among which 87% of them are not against for it.

85% of Netizens which participate in this survey have lived in Guangdong Province. It is found that 58.95% of netizens have expressed their support for the CCUS demonstration at sea which will be built up at Haifeng, Shanwei City in Guangdong, and that 28.77% of netizens have taken a neutral stand in it. Meanwhile, the rest of 12.33 of netizens still hold doubt about it.

Almost 40% of interviewees said that they have knowledge on CCUS which uses sulfur oxide, aerosols, water deputation and carbon dioxide to control pollution. Moreover, 34.25% of netizens have a better understanding for the whole process of CCUS. (Source: Linkschina)



报告称经济增长与应对气候变化可实现双赢 (16/09/2014)：一份由世界经济和气候委员会发布的《新气候经济报告》发现经济增长和减碳可以共赢。快速技术创新和新基础设施投

资可以实现在应对气候变化的同时改善经济表现。

该经济和气候委员会由来自全球 19 个国家的 24 位政府、企业、金融界和经济学界领袖组成。该研究由来自巴西、中国、埃塞耳比亚、印度、韩国、英国和美国的顶尖研究团队完成。研究项目的顾问委员会由世界级经济学家组成，主席是斯特恩爵士。(来源：新气候经济学项目)

New Report Says Economic Growth and Action on Climate Change Can be Achieved Together (16/09/2014): The New Climate Economy report released by a commission of global leaders finds that governments and businesses can now improve economic growth and reduce their carbon emissions together. Rapid technological innovation and new investment in infrastructure are making it possible today to tackle climate change at the same time as improving economic performance.

The Global Commission on the Economy and Climate comprises 24 leaders from government, business, finance and economics in 19 countries. A year-long study has been conducted by leading research institutes from Brazil, China, Ethiopia, India, South Korea, the United Kingdom and United States, advised by a panel of world-leading economists chaired by Lord Nicholas Stern. (Source: The New Climate Economy)



联合国气候变化峰会落幕，呼吁各国致力于一个有意义的全球气候协议 (24/09/2014)：联合国气候变化峰会在纽约落幕，呼吁各国致力于在 2015 年的巴黎峰会上达成一个普遍和有意义的气候协议。

来自 120 多个国家的首脑、政府官员和商业领袖参加了为期一天的会议，旨在提升信心、调动资源，推动行动，以在明年的巴黎峰会达成一项普遍性的气候协议。(来源：新华社)

UN Climate Summit concludes with call for 'meaningful' climate accord (24/09/2014): The UN Climate Change summit concluded in New York, calling for "a meaningful universal climate agreement" in Paris in 2015.

More than 120 heads of state or government and business leaders attended the one-day event in a bid to raise ambition, mobilize resources, and generate actions towards a universal climate deal next year in Paris. (Source: Xinhua)



世界首个燃烧后碳捕集与封存燃煤发电机组在加拿大开始运行 (02/10/2014)：萨省电力公司开始全面运行该公司位于边界大坝电站的旗舰 CCS 项目，该项目是目前全球首个商业化运营的燃煤电厂 CCS 项目。

该项目总耗资 13.5 亿美元，采用胺法捕集二氧化碳技术。

该电厂自从今年 9 月份即开始捕集二氧化碳，但直到 10 月 2 日才开始将捕集到的二氧化碳用于强化石油开采，形成完整碳捕集、埋存和提高采收率系统。

边界大坝项目每年将捕集近 100 万吨二氧化碳。驱油剩下的二氧化碳将被注入位于萨省东南部的二氧化碳埋存研究和检测项目中。(来源：环境领导者)

The world's first Post-Combustion Coal-Fired CCS Facility Opens in Canada(02/10/2014): the SaskPower began full operation of its flagship CCS project at the Boundary Dam power plant in Saskatchewan, making it the world's first commercial scale CCS facility at a coal-fired power plant.

The project was completed at a cost of \$1.35 billion and integrates a coal-fired power unit with amine capture technology.

The plant has been capturing CO2 since late September, but only yesterday began piping liquid CO2 to Cenovus Energy's oilfields for use in enhanced oil recovery operations, thereby completing the CCS chain.

The Boundary Dam project will capture around 1 million metric tons of CO2 each year from the power plant. Any CO2 not used in enhanced oil recovery will be stored at the Aqistore project, a CO2 storage research and monitoring project in southeast Saskatchewan. (Source: Environmental Leader)



华能开建中国首个全流程燃烧前 CO2 捕集示范项目 (10/10/2014)：中石化四建公司承担施工的我国首套完全自主知识产权的燃烧前 CO2 捕集示范系统在华能 IGCC 电厂 (整体煤气化联合循环发电厂) 开工建设。

该示范系统是我国第一个全流程燃烧前 CO2 捕集、利用与封存试验系统，由华能清洁能源研究院联合清华大学、中科院过程所等联合研发，是我国发展低碳经济、应对气候变化所采取的重要举措。示范系统将从 IGCC 电站抽取约 10000Nm3/h 的煤气，经过煤气变换反应将煤气中的 CO 转化为 CO2 和 H2，变换后的混合气经过脱硫净化将 CO2 与 H2 分离，可实现年捕集二氧化碳 7 万吨。(来源：中国化工报)

Huaneng Started to Build China's First Full-scale Pre-combustion Carbon Capture Demonstration Project (10/10/2014): Led by Sinopec's Fourth Construction Company, the first Pre-combustion Carbon Dioxide Capture Demonstration System in China, completely independent intellectual property rights owned by China, has started construction in the Integrated Gasification Combined Cycle (IGCC) power plant in Tianjin.

Developed by Huaneng Clean Energy Institute along with Tsinghua University and CAS Process Institute, the demonstration system, which is the first testing one using pre-combustion carbon dioxide capture, usage and storage technology in the whole process, works as a significant measure for low-carbon economy and fight against climate change in China. The demonstration system will extract about 10,000 Nm3/h gas from IGCC power plant, and through gas conversion reactions convert its CO into a mix of CO2 with H2 that will separate CO2 and H2 through purification of Sulfur removal, which can capture 70,000 t CO2 a year. (Source: China Chemical Industry News)



马斯达尔学院和阿布扎比教育委员会赢得在阿布扎比主办第十四届温室气体技术会议的主办权 (20/10/2014)：阿布扎比教育委员会和一个独立的、关注先进能源和可持续技术的、研究为导向的、研究生水平的大学马斯达尔科技学院今天共同宣布阿布扎比赢得 2018 年第十四届国际温室气体技术会议的主办权。两年举办一次的国际温室气体技术系列会议已确定其作为有关温室气体减排技术特别是二氧化碳捕集与封存方面主要的国际会议的地位。该会议被视为碳捕集与封存项目合作的理想平台，自 1997 年成立以来，合并了早期

的二氧化碳去除国际会议和温室气体减排选择会议。国际能源署温室气体研发项目监管国际温室气体技术会议，在北美、欧洲和亚洲之间不断循环。最近的系列会议于2014年10月5日至9日举行，超过1,250个代表团出席了德克萨斯大学在奥斯丁举行的第十二届国际温室气体技术会议。

Masdar Institute and ADEC Win Bid to Host 14th Greenhouse Gas Technology Conference in Abu Dhabi (20/10/2014): The Abu Dhabi Education Council (ADEC) and Masdar Institute of Science and Technology, an independent, research-driven graduate-level university focused on advanced energy and sustainable technologies, today jointly announced that Abu Dhabi has won the bid to host the 14th International Conference on Greenhouse Gas Technology (GHGT-14) in 2018.

Held once in two years, the GHGT conference series has established itself as the principal international conference on greenhouse gas mitigation technologies, especially on CO2 Capture and Storage (CCS). The event is considered an ideal platform for collaboration for CCS projects, since it was formed in 1997 following the merger of the earlier series of International Conference on Carbon Dioxide Removal (ICCDR) and the Greenhouse Gas Mitigation options conference. The IEA Greenhouse Gas R&D Program (IEAGHG) is the guardian of the GHGT conference series, which rotates among North America, Europe and Asia. The most recent event in the series was held from 5-9 October 2014, where Over 1,250 delegates attended the GHGT-12 conference that was hosted by the University of Texas at Austin.

工业技术研究院引进高效钙循环技术——世界首个可实现90%二氧化碳捕集率的划算且有效的解决方案 (21/10/2014): 台湾最大也是世界领先的高科技应用研究机构——工业技术研究院——引进高效钙循环技术来减少化石燃料电厂产生的碳排放。这是世界首个可实现90%二氧化碳捕集率的划算且有效的方法。它利用可捕集二氧化碳的焙烧及碳化循环来降低能耗，这最终使燃煤发电成为清洁电力。高效钙循环技术可使化石燃料电厂最初捕集每吨二氧化碳的成本降低30美元，这比目前每吨58美元的捕集成本节省了一半多。11月，工业技术研究院将因“环保技术”类这一突破而获得2014年“R&D 100 大奖”。(来源: ITRI)

ITRI Introduces HECLLOT, the First Affordable and Energy-Efficient Solution to Achieve a CO2 Capture Rate of Up-to-90 Percent (21/10/2014): Industrial Technology Research Institute (ITRI), Taiwan's largest and one of the world's leading, high-tech applied research institutions, introduces High Efficiency Calcium Looping Technology (HECLLOT), a calcium looping technology developed to reduce carbon emissions from fossil power plants. It is the first affordable and energy-efficient solution to achieve a CO2 capture rate of up-to-90 percent. It reduces energy consumption using a cycling of calcination and carbonation method used to capture CO2, which ultimately enables coal-fired power generation to become clean electricity. HECLLOT is able to achieve an initial capture cost lower than \$30 per tonne of CO2 in a fossil fuel power plant, saving more than half when compared to the current capture cost of \$58 per tonne of CO2. ITRI will receive a 2014 R&D 100 Award in November for this breakthrough in the "Environmental Technologies" category. (Source: ITRI)



黑石集团支持采用石油采收率方法来对抗全球变暖 (23/10/2014): 除了其新太阳能和风能合作项目，世界上最大的投资公司之一黑石集团上周悄然宣布将在二氧化碳提高石油采收率上投资7亿美元，利用二氧化碳提高老旧油田的产量。这表明黑石集团相信国内政府即将支持二氧化碳提高石油采收率。这一发展可能对该领域唯一的专营公司丹伯里资源公司是特别好的兆头。

效率是勘探和生产玩家的现代诉求，根据美国能源部的说法，二氧化碳提高石油采收率的开采技术正吸引大多数市场的兴趣。尽管很难预测目前的二氧化碳提高石油采收率，美国商会的分析表明这种第三代的开采方法能在50年内，把美国每天35万桶的石油产量提高到每天4百万桶。为把这些数字放入具体情景中，那就是每天比仅次于沙特阿拉伯的世界第二大石油输出国生产商的伊拉克国家多生产100万桶。(来源: TheStreet)

Blackstone Backs Oil Recovery Method That Fights Global Warming (23/10/2014): Despite its new solar and wind partnerships, the Blackstone Group (BX), one of the world's top investment firms, quietly announced last week a \$700 million investment in carbon dioxide-enhanced oil recovery, or CO2 EOR, the use of carbon dioxide to stimulate production in older oil wells. That could indicate Blackstone believes domestic government support for CO2 EOR to be just around the corner. That development could bode especially well for Denbury Resources (DNR), the only true pure play in the space.

Efficiency is the modern-day battle-cry for exploration and production players, and according to the DOE, the CO2 EOR extraction technique is attracting the most market interest. Although it is hard to get current CO2 EOR projections, analysis from the U.S. Chamber of Commerce suggests this tertiary extraction method can boost production from 350,000 barrels of U.S. oil per day to 4 million bopd for 50 years. To put that figure into context, that is nearly a full million "more" barrels a day than presently produced by the country of Iraq, the second largest OPEC producer behind the Saudis. (Source: TheStreet)



欧盟领导人就一份新的2030年气候与能源协议达成共识 (27/10/2014): 该协议内容包括: 2030年温室气体减排目标为40%; 欧盟能源供应中可再生能源应占比27%，但并没有各国具体目标; 提高能效; 进一步加强电力联网。

该协议的签署使英国可根据电力市场改革安排和在工业运用中对碳捕集与封存技术推广的不断规划，通过所有发电来源的公平竞争环境，用最有效的方法继续执行它实现二氧化碳减排目标的政策。分析表明，在英国能源构成中对碳捕集与封存技术进行最佳推广将为2030年及其以后带来巨大的商业利益。

通过英国碳捕集与封存研究中心的研究与影响开发途径活动，它正与行业利益相关者密切合作以确保英国可运用必要的基础知识、能力及技术人员来支持未来10年预计将实施的碳捕集与封存技术主要拓展项目。(来源: 英国 CCS 研究中心)

EU Leaders Set 2030 Climate Deal (27/10/2014): EU leaders agreed a new climate and energy deal for 2030.

This includes 2030 targets for a 40% cut in greenhouse gas emissions, a 27% overall renewables share in the EU energy supply but no national targets, improved energy efficiency; and greater electricity interconnection.

The outcome allows the UK to pursue its policy of achieving CO2 emission reductions by the most cost-effective means, with a level playing field for all sources of electricity generation under Electricity Market Reform arrangements and ongoing planning for CCS deployment in industry applications. Analysis suggests that allowing an optimum deployment of CCS in the

UK's energy mix will give significant economic benefits for 2030 and beyond.

Through its Research and Pathways to Impact Development (RAPID) activities the UKCCSRC is working closely with industry stakeholders to ensure that the necessary underpinning knowledge, capacity and skilled people will be available in the UK to support the major expansion in CCS that is now expected over the next decade. (Source: UKCCSRC)



中英（广东）CCUS 中心

UK-China (Guangdong) CCUS Center

2009年，中国国务院提出2020年温室气体排放行动目标，并在2010年把广东省列为低碳试点省份。英国能源与气候变化部与广东省发展及改革委员会在广东省省长朱小丹的见证下于2013年9月在伦敦签订了推动低碳合作的联合声明，以深化双方合作，其中强调了开展碳捕集与封存（CCS）合作的重要性。2013年12月18日中英（广东）碳捕集，利用与封存产业促进与学术交流中心，即中英（广东）CCUS中心正式成立。中心致力于推动大型CCUS项目的示范，应对人类面临的温室气体排放的挑战，为中国面对的雾霾、水污染的问题提供国际合作平台，催化清洁化石能源技术产业化，以及培养相关专业人才。

In 2009, China's State Council proposed its 2020 goal for greenhouse gas emissions, and then in 2010 made Guangdong a low carbon pilot province. Guangdong has made remarkable achievements in greenhouse gas emission control to which the UK-China low carbon cooperation has contributed significantly. In September 2013 the UK Department of Energy and Climate Change (DECC) signed a joint statement in London with the Guangdong Development and Reform Commission, witnessed by governor Zhu Xiaodan of Guangdong Province, to strengthen low carbon cooperation. The joint statement highlights the importance of collaborating in Carbon Capture and Storage (CCS). Supported by the Guangdong and UK governments, the UK-China (Guangdong) Carbon Capture, Utilisation and Storage Industry Promotion and Academic Collaboration Centre (the "Centre") was officially founded on December 18th, 2013. The Centre is committed to promoting the demonstration of large-scale CCUS projects to tackle greenhouse gas emissions. At the same time, the Centre will also provide an international collaboration platform for solutions to other local pollution problems (such as haze, water pollution) caused by coal utilization, and to accelerate the industrialization for clean fossil energy technologies and to train qualified professionals.

支持单位： Supporting Institutes



中华人民共和国国家发展和改革委员会
National Development and Reform Commission



广东省发展和改革委员会
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SCCS



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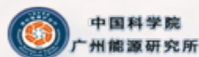
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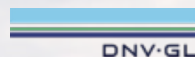
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