洁净天然气带来清新空气

新技术使天然气成为更低价、更环保的燃料

由于政府采取措施限制城市燃煤，中国城市的空气质量得到改善。以北京为例，住宅、学校、医院和工厂的供暖转而使用天然气，不再使用煤炭。这一变革也导致在过去十年中中国对天然气的需求翻了两番。现在，澳大利亚研究人员正在与中国业界合作，使天然气生产过程更加清洁、高效。

中澳都将从中受益。中国的天然气储量巨大，但其中大部分是像煤层气和页岩气这样的非常规天然气。非常规天然气的甲烷含量常不足五成，因此其中的二氧化碳和氮气等杂质必须要除去。一般用冷却法除氮，将天然气中有用的甲烷与氮气分离。这一过程耗能巨大，成本为近数十亿澳元。

澳大利亚也加紧步伐帮助中国满足其对天然气的需求。中国进口的天然气大约有一半是来自澳大利亚的液化天然气（LNG），其中一些液化天然气产自非常规气源。世界上第一批产自煤层气的液化天然气就是在2014 年从昆士兰北部运往中国的。

“由于甲烷和氮气物理化学性质的相似性，将它们分离的过程充满挑战，”西澳大利亚大学的埃里克•梅（Eric May）教授如此说道。

更多合作

Renergi 计划将农作物废料和木屑转化为天然气和运输燃料，从而减少温室气体排放和垃圾填埋。他们采用的是科廷大学和太原理工大学共同研发的技术。

新南威尔士大学与中国制造商携手合作，旨在开发出更低价且更强大的太阳能电池。25年前，新南威尔士大学展示了一种转化效率为 25% 的新型太阳能电池，但这种电池的缺点是生产成本太高。现在，通过使用中国武汉帝尔激光科技等公司的原型激光工具，研发人员已经证明可以低成本实现硅晶片的氢化，从而制造出平价、高效率的太阳能电池，而产品质量是其它工艺的 100 倍。

甲烷是一种威力强大的温室气体，而地下矿井则是甲烷的一大主要来源。澳大利亚联邦科学与工业研究组织（CSIRO）制造了一个 25千瓦的示范发电机，该电机可用矿井废气发电，并在中国淮南煤矿集团的一个地下煤矿进行了试运行。

梅教授的研究团队使用沸石制成分子海绵，通过快速吸收甲烷的方式将其与杂质分离开来。他们生产和测试了几千克的沸石海绵，并与澳大利亚天然气捕集技术公司（Gas Capture Technologies）展开了合作。但工业应用将需要成千上万吨沸石海绵。

“我们与四川省达科特能源科技公司合作，将这些新兴的气体分离技术应用于天然气行业，”梅教授说。“达科特是气体分离领域的专家，他们正在研究如何以商业规模生产沸石海绵。”

合作双方也从大自然中汲取灵感，研发出了另一种解决方案。目前流行的氮气捕获方法要高温高压环境。但是在自然界，三叶草等植物中的细菌可以使用酶金属配合物来固定氮气。该团队研发出了可以在常温下实现上述过程的技术。

这项研究得到了澳大利亚政府全球创新连接计划（Global Innovation Linkages）的支持。

中文版右上角：新南威尔士大学研发的太阳能电池；
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澳大利亚政府

资源与能源

Clean gas, clean air

New technologies are making natural gas a cheaper and greener fuel

Air quality in China's cities is improving thanks to government initiatives to reduce urban coal burning. In Beijing, for example, homes, schools, hospitals and factories are switching from coal to gas for heating. As a result, demand for gas has quadrupled over the past decade. Now Australian researchers are partnering with Chinese industry to make gas production even cleaner and more efficient.

Both countries will benefit. China has large gas reserves but much of the gas is in unconventional sources such as coal seam gas and shale gas. The gases from these sources can contain less than 50 per cent methane so impurities such as carbon dioxide and nitrogen must be removed. For nitrogen that usually means cooling the gas to separate the valuable methane from the nitrogen in an energy-intensive process costing billions of dollars.

Australia has also stepped up to help China meet its demand for gas. About half of China's gas imports come from Australia in the form of liquid natural gas (LNG). Some of that gas is from unconventional sources. In 2014 the world's first shipment of LNG produced from coal seam gas left north Queensland for China.

"Separating methane and nitrogen is challenging due to their similar physical and chemical properties," says Professor Eric May, from the University of Western Australia.

His research team have created molecular sponges using zeolite that can rapidly absorb methane, separating it from the contaminants. They've produced and tested a few kilograms of their zeolite sponge and are working with an Australian company Gas Capture Technologies. But industry will need thousands of tonnes.

"We've partnered with Sichuan DKT Energy Technology Company to bring these new separation technologies to the natural gas industry," says Professor May. "DKT are specialists in gas separation so they're working out how to produce the zeolites on a commercial scale," he says.

The collaborative partners are also working on a second approach to the problem, taking inspiration from nature. Current processes for capturing nitrogen involve high temperatures and pressures.

But the bacteria in plants like clover can fix nitrogen using enzyme metal complexes. The team have developed similar technologies that also work at ambient temperature.

The project is supported by the Australian Government's Global Innovation Linkages program.

Photos: Chinese side, top right, solar cells developed at UNSW; all other images courtesy Shutterstock.

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Also...

Renergi is planning to turn crop waste and wood chips into gas and transport fuel, saving greenhouse emissions and landfill. They're using technology developed at Curtin University and Taiyuan University of Technology.

Cheaper, stronger solar cells is the aim of a collaboration between the University of New South Wales and Chinese manufacturers. Twenty-five years ago UNSW demonstrated a new kind of solar cell with 25 per cent efficiency. But they were too expensive to produce. Now, using prototype laser tools from China's DR Laser and others, the research partners have shown that they can cheaply hydrogenate silicon wafers to create affordable high-efficiency solar cells with 100 times the quality of previous approaches.

Underground mines are a significant source of methane, a powerful greenhouse gas. So CSIRO created a 25kW power generator demonstration unit that uses this waste gas to produce electricity, and trialled it at an underground coal mine of Huainan Coal Mining Group in China.

Australian Government

RESOURCES AND ENERGY