China – The Role of Gas

An online panel event held on 21st and 22nd September 2022

Session Two: CCUS and the GAS SECTOR

Participants

Simon Goess, Carboneer
Benoit de Guillebon, Project Lead, Pycasso (major CCUS installation, Basque region)
Kevin Tu, China Expert, Agora Energiewende
Lauri Myllyvirta, Lead Analyst, Centre for Research on Energy & Clean Air (CREA)
Moderator: François Issard, International Energy Consultant and China expert

Highlights

Carbon capture, utilisation and storage (CCUS) has a huge potential for carbon footprint control and removal, especially in hard to abate sectors, such as steel, chemicals, fertiliser and manufacturing. Individual CCUS facilities capture CO_2 1-2 Mt/yr. If scaled up, capacities of CO_2 5-10 Mt/yr could be reached.

In the last 20 years, CCUS technology has been developed mainly in the form of demonstration projects; it is a proven technology, but widespread application is yet to come.

As CCS and CCUS projects take time to implement, it is important that incentive schemes are politically stable and credible in terms of long-term price development.

It is a question of economics: There are many options to incentivise CCUS, such as financial support, CO_2 pricing and regulation. Carbon markets already give price signals to industry, i.e., CO_2 prices of around €80/tonne in the European Emissions Trading System (ETS). In China, the carbon price is not yet high enough to justify the cost efficiency of the CCUS value chain.

Session Two Summary

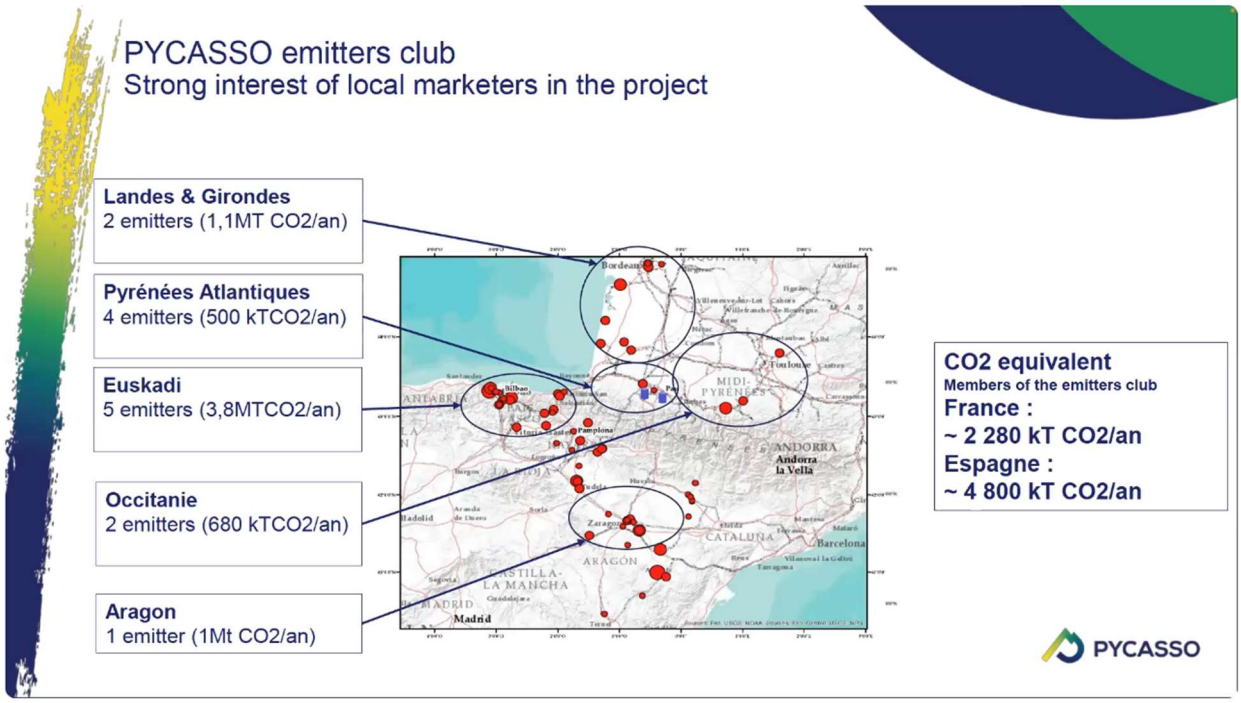
This is a summary, not a verbatim transcript, of the key points made during the online panel event.

Benoit de Guillebon
Project Lead, Pycasso

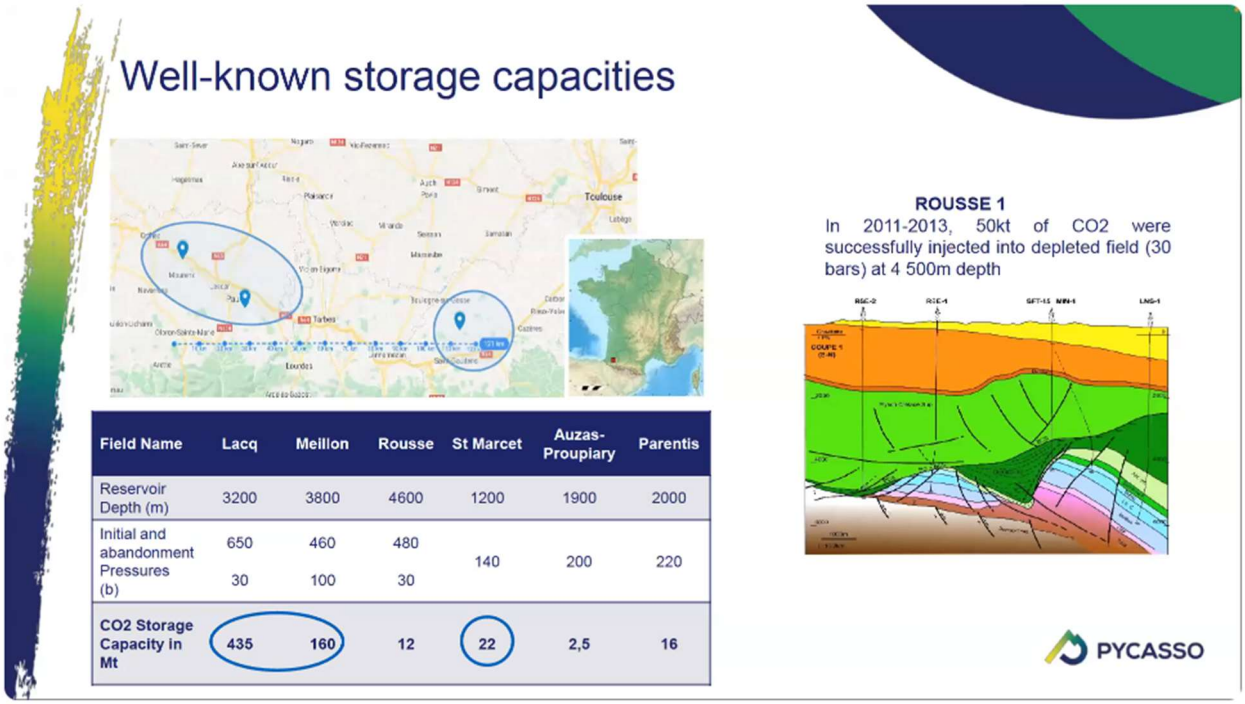
The *Pycasso* project (Pyrenean Carbon Abolition through Sustainable Sequestration Operations) explores how the underground reservoirs in south-west France, which supplied France with gas for 60 years, and the industrial basins built around these gas installations, can provide a low-cost solution for decarbonising industrial activities in south-west France and northern Spain and creating employment for the region.

Roughly 15 Mt of CO_2 emissions have been identified in the project area. About half of the emitters have shown a strong interest in the project, indicating that about 7 Mt of CO_2 will be stored in the future.

Social acceptance: About 10 years ago, 50 kt of CO_2 were injected in the Rousse experiment (2010-13). The smooth implementation contributes greatly to the social acceptance of the Pycasso project.



The storage capacities are well known. Between the two large reservoirs of Lacq and Meillon alone, there is around 600 Mt of CO_2 storage capacity.



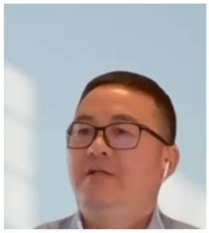
Field Name	Lacq	Meillon	Rousse	St Marcet	Auzas-Proupiary	Parentis
Reservoir Depth (m)	3200	3800	4600	1200	1900	2000
Initial and abandonment Pressures (b)	650 30	460 100	480 30	140	200	220
CO2 Storage Capacity in Mt	435	160	12	22	2,5	16

The core of the project is the creation of a supportive ecosystem of industry, academia, and public stakeholders, building on 60 years of gas exploitation experience;

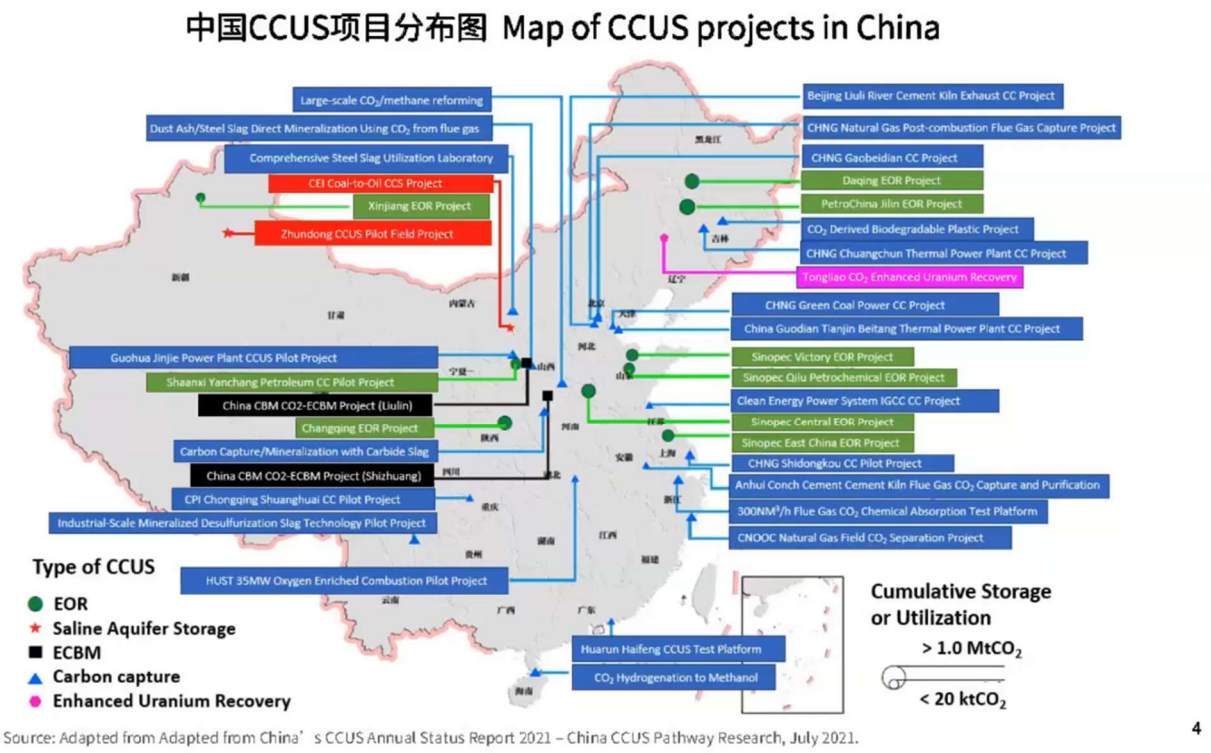
Pycasso was set up in 2021 and is currently in the stage of pre-feasibility studies and the search for funding partners. Detailed technical, economical, environmental and societal studies will follow between 2023-25. First uses and injections are planned in 2028-30.

FI asks: On the territorial acceptation: What kind of support did you have from the government/administration?

BG: First of all, we had the experience of Rousse, which was a pilot of injecting CO_2 in the sub soil. And with the help of the local university, we are designing a social dialogue. At the same time, we are running all the technical projects. We have the support of the regional and municipal governments. The key is to create a dialogue and to answer questions as soon as possible. I, as the project leader, am working very hard on this acceptance. But as you said, the technology is known, it worked 10 years ago, it worked well.

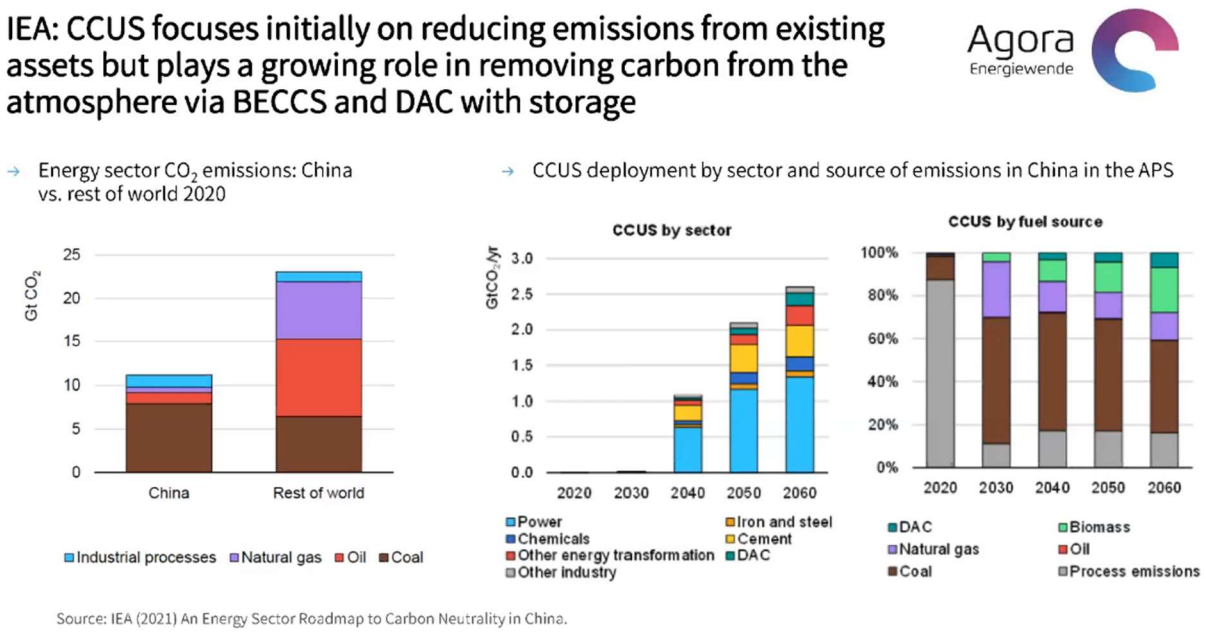


Kevin Tu
Agora Energiewende



CCUS has not met the expectations of the energy community in the past. China already stores several million tons of CO_2, but it emits about one-third of total global emissions. In August 2022, Sinopec put China's first enhanced oil recovery project (1 Mt/y) into operation in Shandong. This involves capturing carbon dioxide from the combustion of coal gas at a fertiliser plant and feeding it into a semi-oilfield for enhanced oil recovery.

Chinese companies were originally very suspicious of renewable energy, but when they realised that European countries, especially Germany, were so serious about solar power generation, they invested heavily. The situation of CCUS is very different because western countries have expressed interest but have not acted on it, so the interest in China is rather subtle. President Xi Jinping's announcement of the 2030/2060 dual carbon target gave new impetus to decarbonisation efforts.



Looking at the IEA report *An Energy Sector Roadmap on Carbon Neutrality in China*, CCUS is expected to play a fairly important role in China's decarbonisation. However, a recent report by Energy Research Institute of NDRC (*China Energy Transformation Outlook 2022*) shows that the energy transition in China is also possible with a rather small role for CCUS. While the energy mix is now dominated by fossil fuels, the report predicts that this will change over the next 40 years, with renewable energy taking on a dominant role, with some emitting natural gas. CCUS should continue to play some role in decarbonising the remaining natural gas in the energy mix.

In China, there is huge potential for CCUS in the coal chemical sector, while in Europe the potential is bigger for blue hydrogen, in combination with natural gas.

There is a limited set of no-regret applications in all sectors that need renewable hydrogen to become climate-neutral.

Agora Energiewende

Green molecules needed?	Industry	Transport	Power sector	Buildings
No-regret	· Reaction agents (DRI steel) · Feedstock (ammonia, chemicals)	· Long-haul aviation · Maritime shipping	· Renewable energy back-up depending on wind and solar share and seasonal demand structure	· Heating grids (residual heat load *)
Controversial	· High-temperature heat	· Trucks and buses ** · Short-haul aviation and shipping · Trains ***	· Absolute size of need given other flexibility and storage options	
Bad idea	· Low-temperature heat	· Cars · Light-duty vehicles		· Building-level heating

* After using renewable energy, ambient and waste heat as much as possible. Especially relevant for large existing district heating systems with high flow temperatures. Note that according to the UNFCCC Common Reporting Format, district heating is classified as being part of the power sector.

** Series production currently more advanced on electric than on hydrogen for heavy duty vehicles and buses. Hydrogen heavy duty to be deployed at this point in time only in locations with synergies (ports, industry clusters).

*** Depending on distance, frequency and energy supply options

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For green hydrogen, there is a very limited set of no-regret applications in all sectors, including in the iron steel manufacturing sector, where direct hydrogen application could play an important role. In cement production, CCUS is arguably the most effective way.

Simon Goess
Carboneer

CCUS has not yet taken off because it is more expensive to implement than paying the carbon price; in addition, there is more government support for renewables than for CCUS. There are various ways to incentivise CCUS and CCS (see slide below).

Instruments to incentivize CCUS

› Numerous options to support scale-up

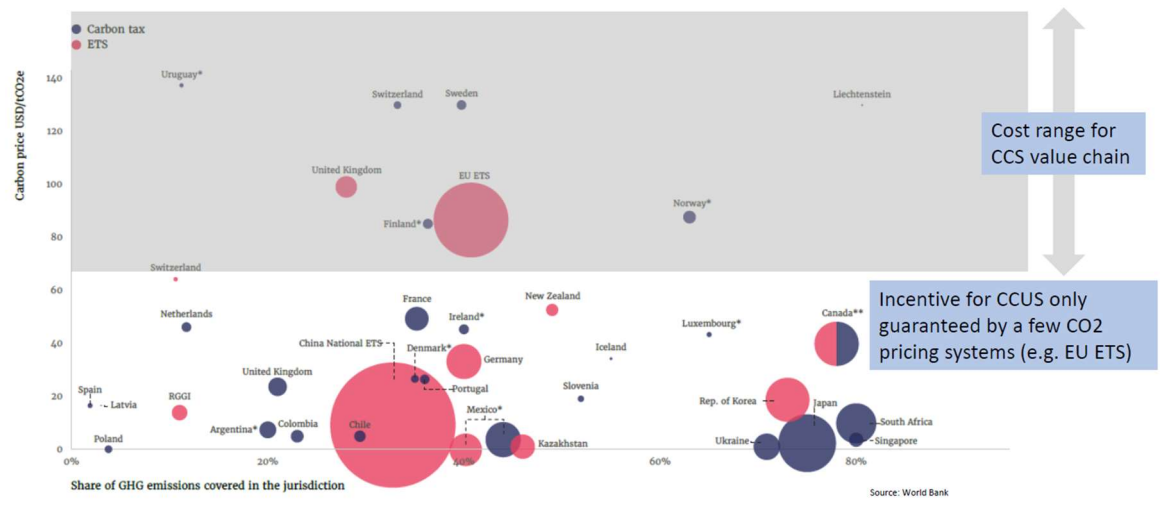
› Complex interaction of instruments with existing market mechanisms

Instrument	Mechanism	Examples
Financial support	Grants and loans	US, EU (Innovation Fund), UK, Norway
	Tax breaks	US (45Q)
	Contracts for Difference	NL
CO2-pricing	CO2 tax	Many countries
	Emission trading system	EU (EU ETS), China, California
	Carbon border adjustment mechanism	EU (in preparation)
Regulation	Emission standards	Canada
	Legal requirements	Australia
	Regulated infrastructure	UK
Other options	Public procurement / auctions	EU, US, Sweden
	Reduction of financing risks (loan collateralization, risk sharing)	Australia

The potential cost range for CCS value chains starts from $70/tonne up to $150/tonne. Most carbon pricing schemes don't incentivise investments, because prices are too low.

The European ETS has been in place since 2009, but for a long time CO_2 prices were around €5- €10/tonne and offered no incentives. This changed in 2020/21, when these prices rose to €70- €100/tonne, creating incentives for carbon storage in industry.

Level of CO2 prices in different countries



The *EU Innovation Fund* provides financial support for energy conversion technologies, including CCUS, financed by revenues from the European ETS (estimated at €38 billion until 2030).

Sustainable Carbon Cycles (new regulations on EU level coming)

› Targets and strategy for carbon cycles, CCUS and carbon removal at EU level

Carbon Farming	Industrie, CCUS, technological removal	Carbon removal certification
› 310 million metric tons of land- and nature-based negative emissions by 2030.	› Industry reporting obligations from 2028	› Regulatory framework for certification of various CDR technologies
› Development of new support mechanisms for carbon farming	› 20% of carbon in chemical and plastic products from non-fossil sources by 2030	› Focus on MRV processes also for industrial CCUS
› Standardization of Monitoring, Reporting, Verification (MRV)	› 5 million tons/year of technical carbon removal and storage by 2030	› Proposal for CDR certification in the EU (end 2022)
	› Dedicated funding programs for industrial CCUS and CDR applications (Horizon Europe)	

Simon Göß
The Future of Gas – CCUS for the gas sector, 21.09.2022 7 carboneer

Lauri Myllyvirta
Centre for Research on Energy & Clean Air

The IPCC states that CCUS is indispensable, but it is important to be very specific about why and for what it might be indispensable. Five reasons why energy modellers use CCUS in their scenarios:

i) Need for negative emissions. There is no way to reach the 1.5 degree mark without removing carbon from the atmosphere.
ii) Hard to abate sectors.
iii) Seasonal balancing of power generation. Basically, all energy system models need catch-all measures for factors that are too complicated to model properly.
i) To avoid stranded assets - adding CCUS instead of dismantling power plants.

Q&A

FI asks: The core of CCUS implementation is about economics. We have been talking about the importance of the carbon price, which is too low in China to provide an incentive. Based on this, do you think, we have enough economic data to launch CCUS projects and what

would be the source of the data if we had to find them to make sure that the projects are going to compete on a level playing field?

KT: We look at how an infant industry should be developed or nurtured. It needs a lot of regulatory and financial support from the government. It is important for authorities in different parts of the world to not only collaborate with each other, but also try to learn from each other how to provide more consistent and long-term signals to key stakeholders to make an investment.

FI asks: How is Pycasso going to survive the coming 10 years?

BG: We have identified the EU Innovation Fund as a good way of financing. Right now we are looking for support from the French government, local authorities and European authorities to get something which is continuous and where we don't need to stop in between because there is no financing.

FI asks: Could you expand a little bit on the view of the economic value of such projects?

SG: To make it a business case, it needs to be clear that this is a long term price trajectory. The difficulty is that these projects take a very long time to be initiated, so there needs to be ongoing financial support. That's also why even though carbon prices in the European ETS went up in the last 1-2 years, not as many CCS projects have been started as expected. Stakeholders in Norway and Sweden are getting more interesting to invest into CCS, because it can help them to cut the costs for CO_2 emission allowances.

FI asks: Do you think that information disclosure by companies is a parallel process that needs to be taken forward together with CCS development?

LM: Absolutely. ESG is driven by public image or marketing purposes. For the high value-added applications where it is really necessary, the logic could be similar to hydrogen, where we are looking for niche markets that could be used to commercialise CCUS. So what are the luxury goods or niche markets for which carbon-free or near-carbon-free goods with CCS could be an attractive proposition?

AUDIENCE QUESTION: Erik Rakhou asks: If CO_2 prices in China were to be at a level of more than €100/tonne (currently around $10/tonne), how would the energy mix develop in terms of natural gas and renewables and what would the timeframe look like?

KT: If we look at the level of carbon prices, we have probably already reached signaling prices in Europe, but there is still not enough investment in CCUS. CCUS is quite a complicated technological issue. Obstacles include the cost effect, legal uncertainty, technological uncertainty and barriers related to public perception. If we look at the future of the energy mix in China, the direction is very certain. If carbon prices are high enough and there is no significant carbon leakage, especially in heavy industry, we are likely to see more renewables and the use of electric vehicles. The future of CCUS depends on other constraints, not necessarily just the level of carbon prices.

LM: I definitely agree. It is important to keep in mind that the Chinese ETS has not been designed to create any incentive to switch from coal to gas or from coal to renewables. It is very specifically designed to drive the reductions in the CO_2 intensity of coal and gas plants. Obviously a lot of things would have to happen before the price would reach a range of €100-200/tonne, currently the system only covers the power sector. And regardless of the price level, it doesn't create this kind of incentive. I don't think that there is an agreement among Chinese policy makers yet that carbon pricing will be the tool that will be used to drive the change in the energy mix that is needed to meet the targets.

AUDIENCE QUESTION: Radhika Badami asks: Nature is a well balanced ecosystem. It generates carbon, it consumes carbon. It generates oxygen. Now, while we are talking all about this technology, why don't we just use nature's own technology?

SG: We will need both: We will have to increase coverage for real negative emissions taking heritage emissions out of the atmosphere, and we will still need to employ certain technical solutions both to take CO_2 out of the atmosphere and also take it away from point sources because the trajectory of the energy systems is too slow to do it alone. As a society, we are moving too slow. This is why we still need CCUS even though you have been hearing about that for 20 years and not much has happened. In addition to that, of course, building forest coverage is an important thing. However, you have to take into account that forestry is not, as such, a sink that solves everything. It also has to be monitored. You have to make sure that the land is not being used for something else.

FI: Trees are already being planted everywhere, but if you calculate the amount of trees an individual needs to compensate for their own energy consumption, it becomes apparent that trees alone do not solve the problem.

BG: CCUS is a transition solution. Clearly we have built an economy and an industrial system which is far from nature. Now we need to go back to a better equilibrium. There is a trajectory, but we cannot change everything very rapidly. CCUS is part of the transitional solution, in 40-50 years we should have developed something that brings us more into balance with nature.

KT: It is widely recognised in the Chinese energy industry that about 10% of China's current carbon emissions could be offset by so-called nature-based solutions. However, if emissions increase further, it will be difficult.
AUDIENCE QUESTION: Sean McQuaid asks: Are you trying “CCS plus” in Europe, where you inject more CO_2 than you emit through enhanced oil recovery?

KT: When we talk about enhanced oil recovery, it's a utilisation of carbon dioxide. It’s a transitional technological solution because if we look at the carbonised world, we don't need so many fossil fuels anymore. So it is only a temporary solution.

Summary compiled by Helena Uhde
Produced by Energy Post