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King Abdullah Petroleum Studies and Research Center

Commentary

Carbon Sequestration Units (CSUs): A New Tool to Mitigate Carbon Emissions

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Climate experts highlight the urgency of cutting carbon emissions to net zero by 2050 if global warming is to be restricted to 1.5 C above pre-industrial levels.

The United Kingdom's decision to aim for net zero emissions by 2050 and to enshrine it in law raises the bar for global policymakers as the world seeks to limit the impact of climate change. A recent European Commission paper outlined policy pathways toward carbon neutrality by 2050, but European governments are still at loggerheads as to whether to adopt the target. Climate experts highlight the urgency of cutting carbon emissions to net zero by 2050 if global warming is to be restricted to 1.5 C above pre-industrial levels.

The principle of net zero emissions is attractive to governments because it does not imply full decarbonization of all economic activities but rather that energy- and industrial-related emissions are compensated by carbon dioxide (CO2) sequestration, either in biological sinks through afforestation and reforestation, or by storage of CO2 in deep geological formations. While many policymakers see forestation as a relatively quick and easy way to create a carbon sink, issues of land availability in densely populated nations and doubts as to the long-term carbon lock-in value of forestation mean that other sink options need to be explored. Carbon capture and storage (CCS) is an obvious alternative solution.

While policymakers are increasingly focusing on carbon neutrality as the primary medium-term policy objective, many climate scientists insist on keeping the world within a 'carbon budget.' This budget is the cumulative amount of CO2 emissions permitted before the 1.5 C temperature threshold is reached, estimated to be between 550 and 900 gigatonnes of CO2 (GtCO2). Recent global annual emissions of 38Gt mean that the carbon budget limit could be reached within the next 15 years. Once the limit is reached, anthropogenic emissions and removals will have to remain in balance in perpetuity, or at net zero, to avoid further dangerous interference with the climate system.

CCS comes into sharper focus when viewed from such a perspective. The world is increasingly facing a stark choice between phasing-out fossil fuels or using CCS or carbon dioxide removal (CDR) technologies and other sink enhancements to maintain a steady-state climate. CCS has to be seen as a key element of the energy transition that will enable the world to achieve the Paris Agreement's aim to limit global warming to 1.5 C above pre-industrial levels.

A lifeline for fossil fuels

CCS offers a lifeline to resource-holders whose economic and social models are based on the continued extraction of fossil fuels, by reducing the risk of their assets becoming stranded. However, the wholesale implementation of CCS technology is a long way from becoming a reality. To date, just 18 large-scale integrated CCS projects have been built, most of them by the oil industry for use in enhanced oil recovery (EOR). This process involves captured carbon being injected into oilfields in order to boost reservoir pressure and increase oil production.

CCS involves a complex technology chain that includes capturing, transporting and storing the CO2. While each element of the technology is mature, there are issues with technical integration and the development of integrated business models along the chain. Simply put, CCS is technologically feasible but expensive. Clearly, a technology-specific incentive mechanism is required to kick-start the uptake of CCS globally.

A recent KAPSARC paper proposes the creation of a new tradable asset class specific to CCS – a carbon storage unit (CSU) – that could provide the necessary stimulus for the uptake of CCS (Zakkour and Heidug 2019). A CSU-based technology mechanism could complement and supplement incentives for CCS coming from the pricing of CO2 emissions and would support the deployment of CCS as a technically mature emissions-mitigating technology.

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Supporting the Paris Agreement

The Paris Agreement established ambitious targets but relies on a voluntary mechanism to achieve them. All signatory countries set their own goals in the form of nationally determined contributions (NDCs) and are expected to communicate them every five years. NDCs should become increasingly ambitious over time, but countries are free to choose their own strategies to mitigate greenhouse gas (GHG) emissions. The agreement represents a departure from the top-down, two-track, architecture of the Kyoto Protocol and allows countries to embark on cooperative strategies with other countries in order to meet or exceed the level of ambition set out in their own NDCs using a range of mechanisms outlined in Article 6 of the Agreement. The aim is to open up opportunities to explore new avenues for flexible forms of collaboration among countries to deliver mitigation outcomes, particularly where they align around common interests.

As work continues to operationalize the Paris Agreement's rules, it is time to consider what a new approach to CCS might involve. In the first instance, any new mechanism for CCS should be guided by the specific characteristics and needs of the technology and lessons from the past. Key issues associated with mobilizing CCS deployment include:

1. CCS is an expensive mitigation technology that will benefit from greater deployment to drive cost reductions. While CCS remains economically feasible in some circumstances, it is not commercially replicable on a widespread basis.

2. Current climate policies and measures do not adequately value the role of CCS as an option for avoiding dangerous climate change. Emergent technologies like CCS need dedicated support policies to guide them from demonstration to technical maturity. The experience of the EU Emissions Trading Scheme (EU ETS), for example, consistently shows that carbon pricing has been effective in driving short-run, marginal, investment but has so far failed to offer a sufficiently stringent, predictable and stable long-run price signal to drive systematic investment into innovative low-carbon technologies.

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3. CCS is a chain of technologies, each of which is proven, but integrating them will pose challenges. The division of risks and knowledge between different parties across the process chain also presents challenges for creating investment-grade projects.

Global cooperation on CCS is essential if it is to move forward. Because CCS costs relate solely to reducing CO_2 emissions rather than other co-benefits, utilization options excepted, capturing and storing CO_2 in isolation offers first-mover disadvantages for both countries and corporations. Multilateral climate action is therefore important in managing financial and economic risks for public and private investors.

A club for climate action

The Paris Agreement provides a framework for enabling multilateral cooperation on CCS. For CCS to find a place in the Paris Agreement process, countries will need to make commitments to include it in their nationally determined contributions (NDCs). So far, only 10 first NDCs or intended NDCs (INDCs) submitted by Parties refer to the use of CCS, while a further 31 simply mention it as a technology to be monitored under their NDC. Only Saudi Arabia and South Africa make quantified forward-looking statements on deployment contributions, while the other NDCs contain loose statements regarding the potential of CCS.

The Paris Agreement supports cooperation between countries in pursuit of NDCs through the option for countries to form ‘climate clubs.’ There is thus the possibility of establishing a CCS club comprising countries wishing to cooperate on CCS technology as part of their NDCs.

Table 1. CCS in NDCs.

Countries with explicit reference to CCS technology in their NDCs	Bahrain China Egypt Iran Iraq	Malawi Norway Saudi Arabia South Africa United Arab Emirates
Countries listing CCS as a source sector category in their NDCs	European Union* Japan	Mexico Montenegro
Countries not mentioning CCS in their NDCs but with potential interests in the technology	Australia [1] Brazil [1, 2] Canada [1, 2] Colombia [1] Indonesia [3] South Korea [1]	Malaysia [3] Russia [1] Thailand [3] Trinidad & Tobago [3] United States [1, 3] Vietnam [3]

Notes: * 28 member state countries. 1 = Member country of either CSLF, the IEA Greenhouse Gas R&D Programme or the Global CCS Institute.
2 = active CCS pilot, demonstrator or large-scale plant(s) in operation.
3 = Significant energy sector emissions and potential for low-cost CCS from high purity sources.

The primary purpose of such a club will be to pool finance and technical resources from countries willing to put CCS deployment as a prominent part of their climate mitigation strategy, both domestically and via plurilateral processes. Such a club would not necessarily need to include all countries but would need to be an enthusiastic group with the motivation, technical interest and financial capability to deploy CCS. Membership could increase over time, based on demonstrated benefits drawn from early experiences with the technology.

A key issue facing countries wishing to promote the creation of a CCS club is to convince other states of the value proposition. In particular, they need to show how such a club differs from other groups focused on CCS already operating outside the auspices of the United Nations Framework Convention on Climate Change (UNFCCC), such as the Carbon Sequestration Leadership Forum, the Clean Energy Ministerial, the IEA (International Energy Agency) Greenhouse Gas R&D (research and development) Program, among others. These groups primarily focus on research and development cooperation and tend to operate as fora for dialog and the sharing of best practices rather than as platforms through which to drive CCS deployment through concrete support mechanisms. A CCS club as envisaged here would serve as a conduit through which to aggregate, channel and disburse the finances of club members to CCS project activities.

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A new mechanism: Storage certificates

KAPSARC is proposing the creation of a new CCS-specific mechanism to incentivize the uptake of this technology in the form of a new dedicated unit – a carbon storage unit (CSU). Rather than being measured as avoided emissions, emissions reduction or emissions removal per se, a CSU would represent a verified record of a tonne of CO2 or carbon securely stored in a geological reservoir. This would allow CSUs to function as a complementary and supplementary incentive alongside carbon pricing policies aimed at reducing emissions, without any risk of double counting. CSUs would become an essential element in the policy toolkit of CCS clubs.

A CSU is similar to a renewable energy certificate (REC), also known as a green energy certificate or a tradable renewable certificate. RECs offer proof that energy has been generated from renewable sources such as solar or wind power. When coupled with the placement of a renewables obligation on electricity generators, a REC subsidizes renewable power in a way that complements carbon pricing. Each REC represents the environmental benefits of 1 megawatthour (MWh) of renewable energy generation. When an entity purchases a REC, renewable energy is generated on its behalf.

The CSU KAPSARC is proposing is a tradable non-tangible commodity that acts as proof that a tonne of CO2 has been safely stored in geological formations. It would have no intrinsic emissions reduction value but would provide a verified record of geological storage. While conventional carbon pricing uses penalties to achieve emissions reductions, a CSU provides an upstream incentive for undertaking CCS.

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A pledge to procure CSUs in an NDC would represent a financial and technological contribution toward CCS deployment with the implicit co-benefit of emissions reductions. The CSU concept has parallels with other types of 'non-GHG' targets evident in some current NDCs, such as megawatts (MW) of installed renewable energy capacity, gains in energy efficiency for certain sectors or appliances, or land area targets for afforestation. These 'non-GHG' targets are expressed in terms other than emissions or removals, such as MWs of renewable energy deployed or square kilometers of newly forested land.

Demand for CSUs would be established in the pilot phase through a results-based climate finance (RBCF) mechanism, an established method used in other areas of climate policy. RBCF involves producing flows of finance from a centralized fund to procure quantified emissions reductions or removal units in situations where other sources of demand do not exist. This would be the situation facing CSUs in a transitional period. In practice, CCS club members would pledge to procure CSUs and establish a fund that, using RCBF, enters forward contracts to purchase CSUs from CO2 storage operators at agreed prices, volumes and timeframes.

Over the longer-term, RBCF could transition to a mechanism that creates systematic demand for CSUs. One option would be to disband the CCS club, with CSU purchases becoming part of mainstream NDC pledges. Another option would be for fossil fuel extractors or suppliers to make voluntary pledges or take on an obligation — for example, via a low carbon fuel standard — to surrender an amount of CSUs proportional to the amount of carbon they extract from the geosphere. The pledge or obligation could be increased over time, in line with the goal of achieving a net zero outcome. Alternatively, either CSUs or carbon pricing alone could be used as a single incentive to promote CCS, depending on experiences gained from the pilot phase.

The benefits: A win-win for resource-holders and consumers

By addressing some of the barriers that have held back the development of CCS, the CSU allows for the continued use of fossil fuel while meeting the aims of the Paris Agreement. Its advantages include:

- Applicability to a wide range of countries and circumstances. Given the barriers to CCS deployment, this new mechanism can be easily adopted by any Party to the Paris Agreement. This need not necessarily involve establishing a single price signal for all, but rather a variable mechanism that can be tailored to specific national circumstances, individual projects, and the availability of other sources of finance and revenue.

- This mechanism fits well with the current CCS technology chain. Given that carbon pricing alone is unlikely to sufficiently incentivize significant investment in CCS, CSUs will add an additional layer of finance to kick-start new CCS projects. The CSU addresses the shortcomings of carbon pricing policies and adds value to resource-holders and consumers while making a long-term contribution to climate change mitigation goals.

- CSUs are compatible with the Paris Agreement architecture, mechanisms and goals. A new layer of finance for CCS can be an integral element of NDCs and internationally transferred mitigation outcomes (ITMOs). It could also dovetail with national or regional carbon pricing schemes and other incentive programs that include CCS, allowing CSUs to drive deeper ambition than can be achieved through a common price signal for all types of CO2 emissions abatement technologies alone.

- CSUs address commercial barriers to CCS deployment. Carbon pricing only offers an incentive for CO2 emitters, whereas viable CCS markets work best when a price signal is offered to both emitters and storers of CO2, as is the case with EOR. A price signal for emitters and storers of CO2 provides the basis for structuring commercial transactions around the transfer of physical CO2 between parties across a CCS process chain. It also creates an incentive for industries with relevant sub-surface technical skills and know-how to seek viable geological storage sites.

CSUs are compatible with the Paris Agreement architecture, mechanisms and goals.

References

Zakkour, Paul, and Wolfgang Heidug. 2019. “A Mechanism for CCS in the Post-Paris Era: Piloting Results-Based Finance and Supply Side Policy under Article 6.” KAPSARC discussion paper. Doi: 10.30573/KS--2019-DP52

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