ERF CCS-CCUS METHOD SCOPING PAPER SUBMISSION

7 August 2020

Emission Reduction Fund – Carbon Capture Storage/ Carbon Capture Utilisation and Storage

H2SEQ would like to thank the Department of Industry, Science, Energy and Resources, for the opportunity to comment on the Emission Reduction Fund - Carbon Capture Storage / Carbon Capture Utilisation and Storage draft policy.

H2SEQ is an industry-led Hydrogen Industry Cluster focused on sustainably growing the Hydrogen industry ecosystem in Queensland and Australia. Our cluster joins industry bodies, research institutions (QUT, Griffith University), businesses, large companies and specialist services that contribute to the value chain.

This submission takes the collective input from members of the cluster and focuses on carbon capture for new projects. The submission does not address all the technical details of CCS/CCSU where the methodology proposed is outside H2SEQ area of expertise.

H2SEQ understands the ERF and this policy's primarily focuses is on grandfathering existing large emitters of CO2 but contends further support should be provided for new industry development that reduces, avoids, and abates emissions overall. Future Hydrogen generation from hydrocarbons projects will rely on the revenue from abatement of emissions to include the CCS and CCUS processes. The ERF lacks mechanisms to provide adequate support for new industry development in emission reduction.

Hydrogen is both an energy store and a fuel and there are no identifiable government incentives or support mechanisms developed to facilitate the industry's development. In other international markets, Europe, Japan, China, and the USA there are examples of market and government incentives to support the industry's development and implementation. Australian hydrogen exports will be competing with these subsidised markets.

H2SEQ strongly recommends a mechanism for accessing ERF resources to support the development of the hydrogen industry in Australia for both export and domestic use.

The Australian Government's Technology Investment Roadmap, Discussion Paper clearly identifies hydrogen and CCS/CCUS as technology that will help Australia address its climate challenge and meet international agreements to reduce carbon. Further Australia and Singapore have a memorandum of understanding to work together on practical projects or initiatives in developing hydrogen markets, supply chains and standards; Carbon Capture, Utilisation and Storage (CCUS); and renewable electricity trade.

The pathway to hydrogen industry commercialisation in Australia will include the mass production of brown and blue hydrogen before green/clean hydrogen due to technology readiness. Brown and blue hydrogen is necessary in activating the production side of the industry, and financial incentive to implement CCS/CCUS will be essential to drive down production cost. Once established renewable hydrogen production is predicted to be more cost effective due to the high cost of CCS/CCUS. Australia's competitive advantage is likely to be in renewable hydrogen production.

We welcome any opportunities to collaborate for successful activation of the hydrogen industry.

For further information please contact Diane Hinson
diane.hinson@leadengineeringsolutions.com.au

H2SEQ Recommendations CCS/CCUS

Recommendation 1: The crediting period should be appropriate to the type of project deployed and its designed operating life, as it is fulfilling its intent of reducing emissions. Initially a default of 7 years can be applied and modified accordingly by the project proponent. As more project types and applications are known, guidelines can be developed for crediting periods per project type.

Recommendation 2: Allow extensions to the start of the crediting period, as 18 months may not be sufficient in proving reliability and accuracy of measurements for Greenfield facilities due to project and commissioning delays.

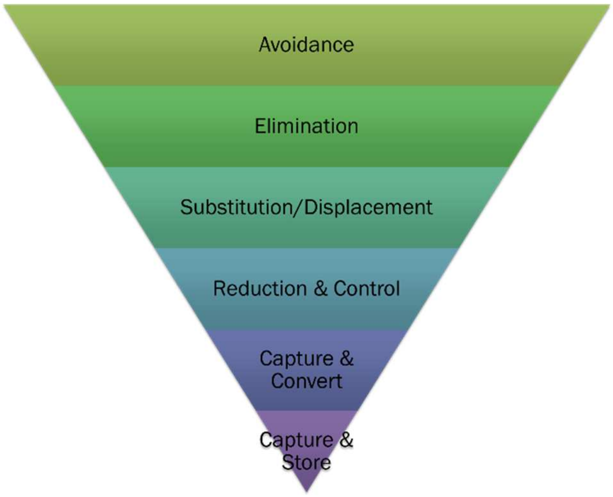
Recommendation 3: The development of more defined measurement and verification standards for new technologies particularly for CCUS.

Recommendation 4: To facilitate a proactive approach in reducing and driving down emissions, a top down as well as a bottom up approach for capture and sequestration. The current approach of projects in the ERF and this proposed method for CCUS projects is the bottom-up approach, whereby projects calculate their emissions abatement and/or capture in isolation. A top-down approach would set targets to meet at a macro-level and support projects that enable those targets to be met.

Recommendation 4: A stronger focus on overall reduction of emissions is required, rather than a business as usual grandfathering of existing long-term emitters. Further investigation is needed into a long-term strategy of emissions, where sequestration is just one of the solutions.

The grandfathering process is a reactive approach in reducing emissions, as emissions have already been emitted and exceeded, giving large emitters little incentive to proactively address root causes of emissions (e.g. reliability issues leading to flaring at gas plants) or go beyond business as usual to reduce, avoid or eliminate emissions.

Recommendation 5: The ERF should add a focus on decarbonisation along with its current process. Decarbonisation will allow Australia to follow suit of other developed countries, provide energy diversification (noting that Australia is heavily reliant on carbon-based fuels and that Australia's fuel inventory is below IPA security levels). This will allow for proactive strategies for reducing, avoiding, and even eliminating emissions. To significantly reduce emissions a hierarchical approach of Avoid, Eliminate, Substitute, Reduce, Capture and Convert, Capture and Store should be considered, with encouragement on Avoid and Substitute. This approach is comparable to the waste management pyramid in place throughout Australia.



Recommendation 6: Should Recommendation 3 & 4 be adopted, Government incentives, funding bodies (such as ARENA, CEFC, CRCs, innovation programs at Federal & State level), the Technology Investment Roadmap plans and instruments like the ERF need alignment to ensure capital is deployed to meet the long-term targets and the industries and capability required to address them. Capital deployment needs to support the industries, associated cross-industries, workforce capability and vertical integrations with oversight at the industrial macro-level.

Stakeholder Comment

3.2 Measurable and Verifiable

Are there any existing frameworks, other than the ones identified at Attachment A, that the Department should consider when designing the proposed CCS/CCUS method?

H2SEQ is not aware of any existing frameworks not identified in Attachment A, and these frameworks appear to be best practice globally.

We support utilising any existing tried and tested methodologies with an ongoing gap analysis of new methodologies required for new industries like hydrogen.

4.1 Factors shaping the scope and design of a CCS/CCUS method

Considerations:

1. Whether CCS/CCUS methods should be developed as 'sequestration' or 'emissions avoidance' methods.
2. How the standard 18 month maximum crediting period start date extension might impact on CCS/CCUS projects' viability.
    - how these impacts could be mitigated.
3. Factors that should be considered in deciding the length of suitable crediting periods and extended accounting periods for CCS/CCUS methods.
4. Appropriate combination of crediting period length, extensions to that crediting period and extended accounting periods that would strike the right balance between providing a sufficient incentive and ensuring additionality and permanence of abatement.
5. How this balance may vary between different CCS/CCUS technologies and activities.

Comments

1. CCS/CCUS should be developed as both sequestration and emission avoidance. The policy longer term goal should be to reduce overall emissions both through capture and reduction. Enabling established industries to continue to emit at current levels would be a perverse outcome of the policy.
2. The crediting period and crediting start date therefore need to account for whether projects are Greenfield, where emissions are estimated, versus Brownfield sites where a baseline is known and relatively easier to measure. These should be designed to be practical and reasonable for industry to be incentivised in addressing emissions at the time of generation.

   The 7-year crediting period is unreasonable for CCS/CCUS and other Greenfield emissions reduction projects where there are ongoing emissions reductions taking place until the end of project's design life. For such projects, crediting should continue in perpetuity so long as the unit is in operation and maintains its emission reduction capability. Therefore, the crediting period should be appropriate to the type of project deployed and its designed operating life, so long as it is fulfilling its intent of reducing emissions. Initially a default of 7 years can be applied for hardware and plant installations and modified accordingly by the project proponent in consultation with the Clean Energy Regulator. As more project types and applications are known, guidelines can be developed for crediting periods per project type.

   The crediting start date of 18 months maximum from registration may be insufficient for some Greenfield projects, as they will require the facility to be fully commissioned to accurately measure the abatement which may void the declaration at project registration. Given also that both Brownfield and Greenfield projects can overrun in schedule, the start date of the crediting period must allow for project delays.

   Crediting should occur when the measurement accuracy is established and performance is guaranteed, rather than basing on an estimate at the design phase. In the case of geological sequestration where permeations can have an effect on sequestration capability, there needs to be a means of validating and adjusting the credited amounts based on estimations at design phase. In all cases, performance validation should be deployed akin to established methods such as Lender's performance tests.

   Crediting should be reflective of the process or equipment unit's performance on a monthly or yearly basis, to incentivise operations in optimisation and continuous improvement of their capture. Wherever possible, if the performance exceeds a benchmark there should be an ability to sell ACCUs at a premium or gain increased credit.

   For the case of technologies where CO2 can leak or there escape from storage, a credit relinquishment mechanism should be available as an insurance policy, rather than have the operator having to purchase offsets. This mechanism would also be reflective of the incident and performance in their operations.

3. Further consultation with industry may be necessary to understand the dynamics of the investment in CCS/CCUS. Agree with paper position that in most other cases, CCS/CCUS projects are not financially viable in their own right, and therefore it is expected that a regulatory requirement or an additional financial incentive would be needed to support the implementation of CCS/CCUS technologies in Australia in the near term.
4. The cost of capture is a significant barrier to the adoption of sequestration methods, both from a capital and operating expenditure perspective. There are various CO2 capturing technologies, but they generally increase the cost of CCS project by 70-80%. The methodology will need to balance the differences in retrofitting capture to existing emitters that might be halfway through their economic life, as well as projects in flight.
5. As above
6. As above

4.2 Technology

Considerations:

1. whether there are other factors that should be considered in prioritising CCS/CCUS technologies/activities for method development;
2. what types of CCS/CCUS technologies/activities are commercially ready but facing barriers that could be overcome by incentives provided under the ERF in the short term;
3. what types of CCS/CCUS technologies/activities are likely to develop over the medium-term to a level that will allow them to deliver large-scale, low cost abatement, and therefore be considered as viable for ERF method development over the coming years;
4. factors that need to be considered in the development of a timeline/pathway for extending coverage to other technologies/activities.

Comments

1. CCS and CCUS method development should be agnostic on technology and ensure that supply chain issues are considered including transport, storage, and ongoing monitoring.

   CO2 Transport - There are several ways to transport CO2 to the storage site after capturing and separation. From the storage site point of view, a large quantity of CO2 can be transported through pipelines in a low-cost effective way. The cost of transportation, however, depends on the operational conditions, onshore and offshore locations and the size and composition of pipelines.

   CO_2 storage - Selection of a suitable geologic site for CO_2 storage depends on many parameters including physical properties of CO_2 and its phase change under pressure and temperature conditions. Only sedimentary basins with oil and gas reservoirs, deep sandstone and carbonate aquifers, coal beds and salt beds are often targeted for CO_2 sequestration practice.
   Key CO_2 storage aspects include storage capacity, trapping mechanisms and containment.

CO_2 monitoring - CO_2 monitoring during and after injection must be done to ensure that the injected fluid is migrating into the storage site and remined confined. In fact, monitoring is a mitigating measure to evaluate the reservoir behaviour during and after injection.

The method to evaluate CCS/CCUS technology for prioritisation should address at least the following elements:

a. Efficiency or effectiveness of CO_2 capture/transport/storage. The benchmark would be whether the process unit captures or reduces CO2 in a greater volume than it emits.
b. Economic feasibility versus benefit. If the technology is cost prohibitive in a Capex and Opex sense based on the efficiency, then those should not be prioritised.
c. HSE and risk. If the technology presents impacts on the safety and wellbeing of personnel, community and environment disproportionate to the benefit gained then that should be de-prioritised. This may be measured by risk assessment and risk ranking methods.

CO_2 Capture and Storage	CO_2 Transport	CO_2 Storage	CO_2 Monitoring
Measure (Eff_A) • Efficiency • Economic feasibility • HSE risk	**Measure (Eff_B)** • Efficiency • Economic feasibility • HSE risk	**Measure (Eff_c)** • Effectiveness • Economic feasibility • HSE risk	**Measure (Eff_D)** • Lifecycle measurement (cumulative reduction) • Time period measurement (reduction per month/year/etc)

Evaluating the effectiveness of the process then becomes:

$$\textbf{CCS/CCUS Effectiveness} = Eff_A + Eff_B + Eff_C + Eff_D$$

The technology provider should be asked to submit benchmarking test results to establish emissions reduction performance when they register the abatement. The provision of credits should be based on measuring the efficiency of the technology against their own benchmark.

2. Commercially ready technologies and activities include pre-combustion capture, post combustion capture and direct utilisation or conversion of CO2.
Existing post combustion technology includes absorption, adsorption, cryogenic distillation, and membrane separation. Direct utilisation of CO2 is already in place in the food industry for carbonating drinks, decaffeination and as a solvent. There is also potential to utilise carbon injection with hydrogen to mitigate the corrosion caused by hydrogen to pipes as higher end use.

The main barrier to all is cost of installation plus ongoing operational cost. If there is means to guide industry towards an end use of CO2 and/or conversion of CO2 to a higher value product for additional revenue, then that needs to be promoted. Where the ERF can provide incentive perhaps is to help is credit towards the Capex plus greater ability to sell spot ACCUs during the operational phase for reductions achieved above an agreed baseline. Another point to note is that deployment of existing technologies above may require cross-industry thinking, collaboration and learning (e.g. power plant capturing and purifying CO2 for use as a supercritical fluid in waste treatment) which needs fostering as it requires industries to "think outside the box".

3. H2SEQ supports increased incentives for large scale CCUS over CCS, noting the concerns of CO2 leakage from geological sequestration, and prefer reuse of carbon to provide an additional revenue stream to offset the high cost of capture wherever possible.

   Emerging conversion applications include algae conversion via bioreactors, mineral carbonation and carbonates use in construction, conversion of CO2 into green methane, ammonia, and methanol (Methanation) as well as specialist organic compounds via carboxylation. Emerging direct utilisation methods include solvent applications in the pharmaceutical industry, as a supercritical fluid for some waste treatment processes and, conversion to graphite, graphene and carbon fibres.

4. Further consultation with industry may be required.

4.2.3 Modular approach versus discrete method

Considerations:

1. The best approach to accommodating additional forms of CCS in the future, noting the approach to covering any new forms of CCS would need to be consistent with the offsets integrity standards and be subject to consideration by ERAC;
2. Whether certain types or groups of CCS/CCUS technologies or activities would be better supported by one approach over other approaches.

Comments

1. Discrete methods are preferred to allow for technology evolution and focus on the final result of reduction of air pollution. This way, the technology can include whatever process steps are required to meet the ultimate outcome against its own benchmark.
2. Further consultation with industry may be required.

4.3.1 Cradle to Well Approach

Considerations:

How hub and spoke CCS activities could be supported under an ERF method, and specifically whether the cradle-to-well approach is suited to hub and spoke networks.

Comments

The approach to be utilised must consider the overall objective of the ERF. If there is a desire to go the proactive approach and drive down emissions, then the method selected needs to consider the age of the emitting process plant/unit/equipment, the practical abatement that can be gained, whose responsible for the CO2 capture unit, the incentive for the emitting industries as well as those providing CO2 capture services.

Industry will favour the approach that gives them the maximum incentive if they can practically achieve the abatement; it may be that the method selected should be applied on a case-by-case basis initially to gain a better understanding of the dynamics. Take the scenarios below in Figure 1.

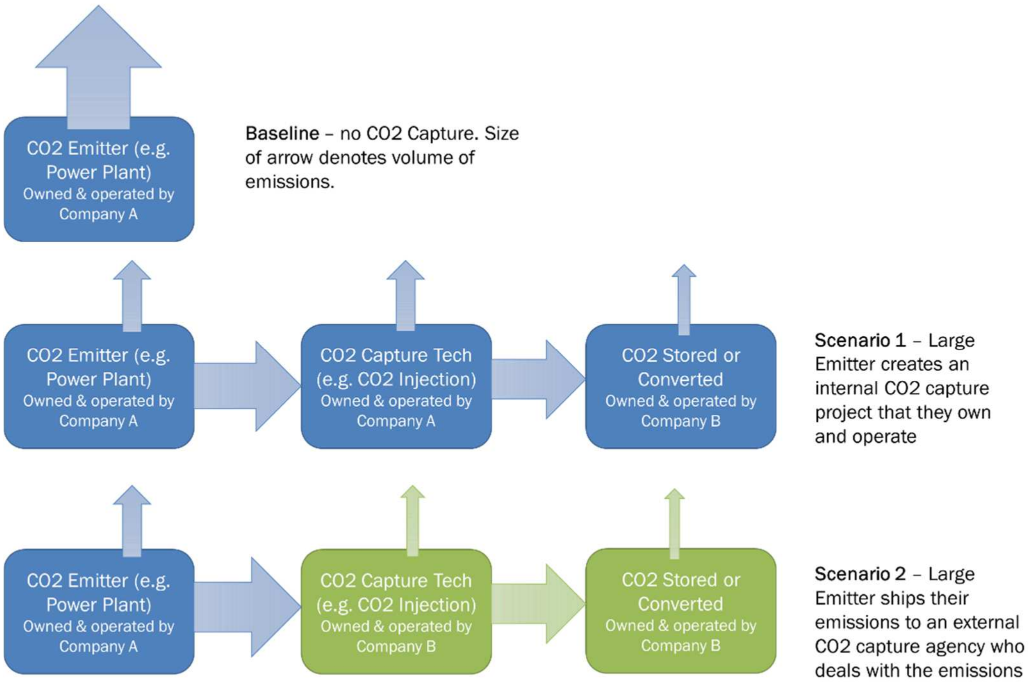


Figure 1 - Use Cases Comparing Each Approach

The Cradle to well is the appropriate approach for scenario 1 cases, for example large emitters who install and operate their own capture system. This will also work well for ageing facilities and operations where their emissions are due to legacy technology and where processes cannot be optimised further to reduce emissions, as the abatement can be referenced from a "Do Nothing" or "Business As Usual" baseline. This method is favourable for these cases as the baseline emissions are significantly larger than project emissions.

The Cradle to Well approach however may prejudice new Greenfield projects developed for the purpose of hydrogen generation combined with CCS and CCUS, as estimating the associated emissions of processes prior to capture and conversion/injection will be highly involved, inaccurate, and difficult to determine in the study stage prior to commissioning. It is also difficult to pin the baseline for Greenfield projects – the project is not built so there is no BAU baseline, so is the baseline based on "what could be"?

See also comments below for the Injection Well Focused.

4.3.2 Injection Well Focused

Consideration:

1. Whether CCS could best be supported under a cradle-to-well based method or an injection-well-focused method; and
2. Whether there are specific types of CCS activities that would make it technically or operationally difficult to use the cradle-to-well approach or the injection-well-focused approach; e.g. any particular CCS activities that include CO2 collection and separation processes that are highly integrated with the primary production activity, making it difficult to measure the relevant emissions and isolate impacts on the emissions profile of the primary production activity.

Comments

1. The Injection Well Focused abatement calculations provides a more stringent test than the Cradle to Well method for determining abatement. This method will only be attractive for processes that can sequester larger amounts of CO2 than what is emitted. This would work in favour of Greenfield projects specifically focused on CO2 capture and storage or reuse; and may benefit technology owner-operators providing a service to large emitters (e.g. bioreactor operators) as per Scenario 2 in Figure 1.

   In the case of Blue hydrogen production by coal gasification and steam reforming, the Injection Well method would suit Greenfield projects of this nature from the dual benefit of CO2 capture and production of hydrogen which will facilitate displacement of carbon fuels.

2. As above

With regards to Scenario 2 in Figure 1, given there are two parties involved this raises the question of who can then claim the credits – would it be the large emitter, who is now paying the service provider or the service provider for lowering the overall emissions? Rules around operational ring-fencing and rightfulness to claim need to be made explicit.

4.4 CCS vs CCUS

Considerations:

1. Commercial readiness and financial viability of different CCUS technologies (we consider CCU to be included in CCUS for the purposes of this paper);
2. Main barriers for the advancement and deployment of CCUS technologies; and • international and national development trends in the near future.
3. The approach to targeting initial method development on CCS activities, with expansion considered in the future.

Comments

H2SEQ in principle supports CCUS as the stronger option providing longer term benefits and increase revenue to offset cost of carbon capture.

CCUS, similar to the hydrogen industry, is cost prohibitive to install, lacks the infrastructure for capture and commercial scale conversion, and has limited markets for CO2 end use. The current CO2 capturing technologies largely increase the cost of CCS project by 70-80% and this cost inhibits continuous improvement let alone use in industry. Advancement of CCUS will require industry studies on reducing the operational cost, commercialisation focus for further research & development of emerging technologies, and additional financial incentives (e.g. ARENA funding focus) or a higher ACCU trading price. It may be that ACCUs will need separate tiers of pricing to encourage certain sectors to adopt CCUS (e.g. Blue Hydrogen production and large emitters) and technologies to be developed. These will need to align to the overall long-term strategy for emissions reduction and displacement.

5.0 Design Options

Considerations:

1. Advantages and challenges that have not been identified in the table for each of the options;
2. Any other suitable method development options that should be considered.
3. The most appropriate method development option to take forward at this stage.

See H2SEQ recommendations for our frame of reference in determining the appropriate options and methodology. **Option 3** is preferred to allow for technology evolution, where technology can be any process that results in air purity improvements.

6.0 Recommended Design Approach

Considerations:

1. What activities/sectors should be prioritised for coverage under the method(s) in the first instance?
2. Whether option 2 or option 3 should be pursued as the preferred abatement calculation approach?
3. The approach of establishing a timeline/pathway for expanding coverage of CCS/CCUS activities over time.

Comments

With regards to expanding coverage of CCS/CCUS activities, it is proposed that encouragement for using existing post and pre combustion capture and direct utilisation should be accelerated so that there is immediate to near-term reduction benefit. Before timelines are committed, it is necessary to be clear on the long-term strategy, goals, and success factors for the ERF.

Acknowledgements:

We would like to acknowledge the following H2SEQ members for their contributions to this paper – Thom Cameron (Aurecon), Rob Ully (Enviro-Value), Janik Soysa (OGP Group), Kim Han Than (OGP Group), Renata Berglas (Queensland Transport & Logistics Council), Aurelia Noran (Infrastructure Project Solutions) and Diane Hinson (Viridius Energy Project).