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Method scoping paper

Carbon Capture and Storage / Carbon Capture, Utilisation and Storage

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Glossary

ACCU – Australian carbon credit units. A unit that represents one tonne of carbon dioxide equivalent (tCO2-e) stored or avoided by an ERF project.

Baseline emissions – The likely level of net emissions from the project over the crediting period in the absence of the ERF incentive

CCS – Carbon capture and storage. The process in which carbon dioxide is captured and stored underground in geological formations. CCS is a subset of CCUS.

CCUS – Carbon capture, utilisation and storage. The process in which greenhouse gases are captured and stored in geological formations, objects or materials.

CER – Clean Energy Regulator. The body responsible for key administrative tasks under the Emissions Reduction Fund including registering projects, running auctions, managing contracts and issuing Australian carbon credit units on achievement of emissions reductions.

CFI Act – *Carbon Credits (Carbon Farming Initiative) Act 2011.* The primary legislation in which the ERF and offsets integrity standards sit.

Crediting period - The period of time an ERF project undertakes activities which generate eligible abatement.

EOR – Enhanced oil recovery. The process through which otherwise inaccessible oil is accessed via the injection of captured greenhouse gasses into depleted oil reservoirs.

ERAC – Emissions Reduction Assurance Committee. The independent body responsible for ensuring an ERF method meets the offsets integrity standards.

ERF – Emissions Reduction Fund. Refers to a set of mechanisms designed to help Australia meet its emissions reduction targets. The ERF credits abatement delivered through projects undertaken in accordance with approved abatement calculation methods.

Methods (ERF) – Defined types of projects that are eligible to earn ACCUs as part of the Emissions Reduction Fund.

Extended accounting period – The period following the crediting period, in which ERF projects report and earn ACCUs for the abatement calculated and accrued during the crediting period. Activities undertaken during the extended accounting period are not eligible to be credited for emissions reductions.

Facilities method – An existing ERF method which provides a high-level, activity-neutral framework to calculate abatement from facilities that report under NGERS.

IPCC – Intergovernmental Panel on Climate Change.

NGERS – National Greenhouse and Energy Reporting scheme. The primary legislation requiring facilities to report their emissions and energy use.

Project emissions – Emissions within the project boundary that occur as a consequence of undertaking the project activities

'Hub and spoke' – a model for CCS in which nearby facilities individually capture and transport greenhouse gases to a central injection-site. Sharing a portion of capital costs theoretically allows lower upfront costs for facilities wishing to participate in CCS.

Offsets Integrity Standards – The criteria that all ERF methods must meet, designed to ensure carbon credits issued under methods represent real emissions reductions that are able to be counted towards Australia's international emissions reduction obligations.

1. Introduction

This paper explores avenues through which emissions reductions generated from carbon capture and storage/carbon capture, utilisation and storage (CCS/CCUS) technologies may become eligible for crediting under the Emissions Reduction Fund (ERF). The paper incorporates feedback received in April 2020 by the Department of Industry, Science, Energy and Resources (the Department) at a Department-led CCS workshop. In considering how best to develop a CCS/CCUS method under the ERF, this paper discusses likely interactions between CCS/CCUS technologies and the ERF framework, in particular the need for any method to meet the offsets integrity standards.

The intent of this paper is to consider design options and map out a method development process that could lead to the timely delivery of a method that is practical and supports genuinely additional and commercially ready CCS/CCUS activities. This initial method could potentially be expanded or used as a template for other CCS/CCUS activities over time.

In sections 5 and 6, the paper identifies three possible method design options and a recommended scope and design is proposed.

2. Background

2.1. Carbon Capture, Storage and Utilisation

Carbon capture and storage (CCS) involves the separation and storage of greenhouse gases underground in geological formations. The Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA) consider CCS to be one of a suite of technologies that can be used to meet global climate change targets. CCS technologies to date have focused on capturing carbon dioxide (CO_2) from industrial processes, gas processing, or electricity generation for storage underground. The majority of large-scale CCS projects in operation around the world involve the separation of CO_2 at gas processing plants and storage in underground geological formations. Carbon capture, utilisation and storage (CCUS) shares many similarities with CCS. CCUS generally involves the capture of greenhouse gases for use in products such as plastics, concrete, bricks, plasterboard and biofuel.

There are a variety of approaches to implementing CCS/CCUS projects, but all have the common elements of capture, compression, transport, and injection and monitoring (or conversion for CCUS). CCS/CCUS processes generally require significant capital investment and in most cases offer a low or negative return. As a result, a number of CCS/CCUS ventures worldwide also involve Enhanced Oil Recovery (EOR) projects, in which captured CO_2 is injected into depleted oil reservoirs to facilitate extraction of otherwise inaccessible oil. The additional resource gained through EOR helps to recoup the high cost of CCS infrastructure, improving the project's financial viability. 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.

2.2. Emissions Reduction Fund

The Emissions Reduction Fund (ERF) is designed to help Australia meet its emissions reduction targets. It is comprised of a crediting mechanism—where abatement projects can earn carbon credits, and a purchasing mechanism—where the Government can purchase issued carbon credits through a competitive auction process. The crediting mechanism is intended to provide an incentive for public and private entities to undertake projects that reduce emissions or increase the sequestration of carbon in vegetation and soils. A number of activities are eligible under the scheme and participants can earn Australian Carbon Credit Units (ACCUs) for emissions reductions achieved in line with requirements set out in ERF methods. ERF methods stipulate the rules that need to be met in relation to the calculation of abatement, and other conditions, such as measurement and reporting requirements. A number of methods have been established to cover activities such as capture and destruction of coal mine fugitive emissions; commercial and industrial energy efficiency; and reductions in the emissions-intensity of transport. Despite the broad coverage of methods under the ERF, none of the existing methods are well suited to support CCS/CCUS projects.

For CCS/CCUS technologies to be eligible for crediting under the ERF, one or more new methods would need to be developed. CCS/CCUS activities, including the calculation of the net abatement attributable to these activities, need to be set out in new methods. To ensure the integrity of ACCUs issued, each method must meet the criteria set out in the ERF offsets integrity standards, which are discussed in section 3.

3. Offsets Integrity Standards

The offsets integrity standards are the legislated criteria that all ERF methods must meet. They are based on international standards and ensure carbon credits issued under ERF methods represent real emissions reductions that can contribute towards meeting Australia's international emissions reduction obligations. There are six offsets integrity standards, which are set out in section 133 of the *Carbon Credits (Carbon Farming Initiative) Act 2011* (CFI Act).

Standard	Section	Summary description
1. Additionality	133(1)(a)	Result in abatement that is unlikely to occur in the ordinary course of events
2. Measurable and verifiable	133(1)(b)	Removals, reductions and emissions are measurable and capable of being verified
3. Eligible carbon abatement	133(1)(c)	Abatement can be used to meet Australia's international mitigation obligations
4. Evidence-based	133(1)(d)	Method is supported by clear and convincing evidence
5. Project emissions and leakage	133(1)(e)	Method provides for deduction of material emissions that occur as a direct result of the project
6. Conservative	133(1)(g)	All estimates, projections or assumptions are conservative

The independent Emissions Reduction Assurance Committee (ERAC) assesses all draft methods proposed by the Department as part of the method development process. Before making a method, the Minister must obtain and consider advice from the ERAC, including on whether the proposed method meets the offsets integrity standards. If the ERAC advises a proposed method does not meet the offsets integrity standards, the Minister cannot make it into a final legislated methodology determination.

In May 2019, the ERAC released an *Information Paper: Committee considerations for interpreting the Emissions Reduction Fund's Offsets Integrity Standards*[1], which contains useful information about how these standards would be considered in the method development process.

In this section, the paper discusses each of the offsets integrity standards, focusing on their potential interaction with the design of CCS/CCUS methods and, in particular, the relevant issues that need to be considered in determining the appropriate scope for a CCS/CCUS method.

3.1. Additionality

To ensure a method is only supporting emissions reduction activities that are unlikely to have occurred in the ordinary course of events, the development process would consider a range of measures.

3.1.1. Eligibility requirements

Eligibility requirements stipulate what technologies, activities or project types are allowed or excluded under the method. For example, to develop appropriate requirements for CCS/CCUS methods, the following factors would need to be examined:

- CCS/CCUS activities that are required or encouraged by a law/regulation or program of the Commonwealth, a state or a territory;
- Commercial readiness and financial viability of CCS/CCUS technologies in the absence of the incentive provided by the scheme, in particular for project types that would deliver material co-benefits, such as increased oil production resulting from EOR projects;
- Types of CCS/CCUS projects that face significant financial or technical barriers that would not likely be overcome by the incentive provided by the ERF. Consideration would also be given to the likelihood of projects being driven by factors other than the ERF incentive, such as a company's research and development strategy or internal climate change policy.

Eligibility requirements in the method are also supplemented by project assessment of the 'regulatory additionality requirement'[2], 'newness requirement' and 'government program requirement' under the Act, legislative rules and methodology determination at the declaration of a project. The combined effect of these filters needs to be sufficient to exclude activities that would have gone ahead in the ordinary course of events from being credited.

[1] Available here: https://publications.industry.gov.au/publications/climate-change/climate-change/government/emissions-reduction-fund/publications/erac-offset-integrity-standards-paper.html

[2] CER is currently developing an updated approach to interpreting the regulatory additionality requirement in relation to state based offset requirements, with an aim of providing greater flexibility to facilitate broader engagement in the ERF. Further information is available at: http://www.cleanenergyregulator.gov.au/ERF/Want-to-participate-in-the-Emissions-Reduction-Fund/Planning-a-project/regulatory-additionality-and-government-programs.

3.1.2. Crediting period

A crediting period is the period of time a project is able to apply to claim ACCUs. A crediting period starts on the date a project is registered or on a start date nominated by the project proponent up to 18 months after a project is registered with the Clean Energy Regulator (CER).

The design of eligibility requirements needs to be considered in conjunction with, and in the context of, the applicable crediting period. For example, to assess the commercial readiness and financial viability of a CCS/CCUS technology, the focus should not be placed on only the current status of the technology. Analysis would need to also examine likely trends in the future, especially over the time period covered by the proposed crediting period. That is, CCS/CCUS project eligibility requirements should not only ensure the additionality of proposed activities at the time of project registration, they should also provide certainty that these activities are not likely to be undertaken under business as usual during the crediting period. Section 4.1 further considers standard and non-standard crediting periods under the ERF.

3.1.3. Baseline setting

The baseline setting mechanism in a method should accurately reflect the likely level of net emissions from the project over the crediting period in the absence of the ERF incentive. Baseline emissions are compared against project emissions to determine the abatement credited under the method. For example, if a CCS/CCUS method uses a standards-based baseline setting mechanism[3], the setting of the production variables and emissions intensity values must take into consideration the improvement likely to occur under business-as-usual conditions, e.g. as a result of replacing retired units or components with more efficient models over the crediting period. If the potential improvement in emissions is not appropriately addressed in the method, non-additional abatement will be credited and the method would not meet the additionality standard. In some methods, this is addressed by applying improvement rates to baseline setting mechanisms, which typically are established using site-specific or sectoral historical data, or overseas performance standards.

3.1.4. Statement of activity intent

Under circumstances where it might be difficult to design a set of measures *at the method level* to systematically separate out projects that would have occurred regardless of the ERF incentive from genuinely additional projects, a 'statement of activity intent' requirement[4] can be considered for use in the method. A similar approach is used in other methods approved by ERAC, such as the Facilities Method. The Department considers that this element of method design can be examined in the detailed method development phase that will follow consultation on this paper.

3.2. Measurable and Verifiable

The offsets integrity standards specify that a method involving the removal, reduction or emissions of greenhouse gases should be measurable and capable of being verified. Measurement and verification techniques appropriate to the activities must be specified in the method.

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[3] A standards-based baseline is calculated based on production variables and their corresponding performance standards, usually expressed as an emissions intensity metric (e.g. tonnes of CO_2 per unit of production). For example, if a CCS project captures CO_2 from a coal-fired power station, a standards-based baseline may be the coal-fired power station's emissions rate expressed as tonnes CO_2/megawatt hour. In this case, baseline emissions would be calculated by multiplying the actual MWhs delivered to the grid in the project condition (net MWh) times the emissions intensity value.

[4] This is a *project-specific* measure that requires the chief financial officer of the participating facility to make a statement declaring that the project is not likely to take place in the absence of the ERF incentive.

How this standard applies to CCS/CCUS projects is highly dependent on the specific CCS/CCUS activities involved. For example, there are a number of existing international and Australian, state and territory government frameworks with detailed measurement and verification methodologies designed to govern CCS, where the captured greenhouse gases are stored in geological formations. In contrast, methodologies that could be used for calculating abatement from CCUS projects are less developed, in particular the utilisation technologies, i.e. the conversion of CO_2 to products. This disparity is largely related to the emerging nature of these technologies. The high volume and quality of evidence required to design an effective and robust measurement and verification framework inherently favours more established technologies, as they have had time to establish a strong evidence base. Robust and effective measurement and verification standards for newer technologies are likely to be developed over time as evidence and experience with those technologies grows.

The offsets integrity standards do not stipulate that measurement and verification techniques must pre-date the method, however they do insist on the specified measurement and verification techniques being rigorous, reliable and robust. Establishing that a new measurement and verification technique is of a sufficient standard to meet this benchmark would require detailed analysis and potentially add to the time required to build a method. For this reason, the measurement and verification measures in a CCS/CCUS method would preferably be based on existing frameworks that are well established and proven.

There are several existing national and international frameworks for the quantification of emissions reductions generated by CCS/CCUS projects, which could be suitable for use in a CCS/CCUS method. Examples of existing frameworks include those used in the Alberta and California Protocols, the American Carbon Registry, and Western Australia's Barrow Island Act. The Australian Government has also developed a framework for quantifying abatement from CCS activities through the inclusion of CCS provisions under the National Greenhouse and Energy Reporting (NGERS) scheme.

Depending on the coverage of eligible CCS/CCUS activities in the method, it could be possible to find compatible components of existing measurement and verification frameworks, which in conjunction with other design components of the method could meet the offsets integrity standards. If a framework is found to be suitable for a CCS/CCUS method, adapting it from its current form may represent an effective and time efficient way of developing a method. It is likely that the use of an existing measurement and verification framework would only be suitable for a limited set of eligible activities, similar to those the framework was designed to cover.

For example, the NGERS measurement and reporting framework, including data reported under NGERS, could be adopted to support certain types of abatement calculation mechanisms for a number of CCS/CCUS activities (see section 4.3 for further discussion). Furthermore, supplementary measures or modifications to the NGERS framework would need to be considered should there be misalignments between the coverage of CCS/CCUS under the framework and the proposed ERF method. For example, NGERS currently does not cover CCU activities, nor does it cover CO_2 transportation other than through direct pipeline transmission. It should also be noted that NGERS only covers CCS activities transferring CO_2 to an underground geological formation that is regulated under national or state CCS legislation. Currently, EOR activities are not covered by CCS legislation in some jurisdictions, e.g. Queensland. (**Attachment A** includes links to the relevant national and state legislative frameworks).

Subject to the method design, in particular the abatement calculation approach that is used in a CCS/CCUS method, emissions released from different stages of CCS/CCUS activities and the amount of CO_2 injected would need to be identified and measured. Although there are multiple existing frameworks that include components that deal with similar calculations, the design concepts and targeted processes vary among them. An important element of method development will be to navigate through these frameworks to identify the most suitable candidates that can be used as the basis for building the required components in the method, with regards to the following factors:

- coverage of the existing frameworks and the proposed method;
- similarities between the legislation underpinning the frameworks and the legislative context in Australia;
- the baseline setting approach used in the frameworks and the proposed approach for the method; and
- the safety and permanence requirements under the frameworks and the expected level of these requirements under the offsets integrity standards.

It is likely that existing measurement and verification frameworks will require modification before they can be adopted under an ERF method that supports CCS/CCUS. The level of adjustment will depend on the extent to which other frameworks align with the coverage and abatement calculation approach to be adopted in the ERF CCS/CCUS method.

Attachment A includes a list of existing frameworks that may be considered in the design of a measurement and verification framework for a CCS/CCUS method.

Stakeholder comment
Stakeholder views are sought on:

- Whether there are any existing frameworks, other than the ones identified at **Attachment A**, that the Department should consider when designing the proposed CCS/CCUS method.

3.3. Eligible Carbon Abatement

The CFI Act defines eligible carbon abatement as abatement that results from carrying out the project, and which can be used under Australia's climate change targets under the Kyoto Protocol and its successors. In other words, this requires a method to only issue credits for abatement that would be reflected in Australia's National Inventory Report. For example, CCS/CCUS methods should only cover removal of emissions from domestic activities, and the injection of CO_2 that is collected and transported from overseas should not be allowed to use the methods. If there are forms of CCS/CCUS that are not supported by the international framework that governs Australia's approach to its inventory calculations, then those forms of CCS/CCUS could not be included in the proposed method.

An important mechanism to ensure methods are aligned with this criterion is to apply the emissions accounting rules imposed and reported on under NGERS. For example, where the NGERS reporting framework deducts emissions captured for permanent storage off the emissions of a facility and does not treat those emissions as emissions of an injecting facility, the reported emissions of the facility can be reflected in the National Inventory Report. However, if the NGERS framework does not account for the storage of the emissions, but they are reported as being emitted into the atmosphere in reporting by one or more facilities, the Government is unlikely to be able to count the abatement in meeting Australia's international targets. It may be necessary to ensure facilities participating in the activity are using relevant NGERs methods for their reporting to avoid this being the case.

Example

Under the NGERS measurement rule, facilities can choose from a number of methods to measure and calculate the emissions associated with a production activity. For ammonia production, Method 2 incorporates the deduction of the emissions captured and sequestered into a licensed injection well, while Method 1 does not deduct these emissions. Therefore, if a CCS/CCUS project were to involve an ammonia plant using Method 1 for its NGERS reports, the associated abatement of the project (i.e. emissions sequestered) would not be reflected in the National Inventory, which uses NGERS data as a primary input.

3.4. Evidence-based

The evidence-based standard requires that a method should be supported by clear and convincing evidence. This requirement cuts across and interacts with other offsets integrity standards. The method development process must be able to demonstrate that the method design elements—such as additionality measures, measurement and verification requirements, and the approach to the treatment of project emissions and leakage—are robust and supported by well-established science and reliable research.

As discussed in section 3.2, if a CCS/CCUS method uses external measurement and verification frameworks in calculating abatement, their credibility and adaptability must be closely examined against the ERF framework. Where gaps are identified, the method would need to include appropriate measures to address aspects that are not sufficiently covered by the existing frameworks. The design of these measures must have regard to proven science and validated research of the relevant technologies (e.g. CO_2 collection and separation technologies) and their application to different industrial sectors.

The application of the evidence-based standard to leakage and permanence issues for CCS/CCUS methods would also require careful and in-depth analysis. These issues have been closely examined in other processes and frameworks, and it is proposed the CCS/CCUS ERF method development process leverage off this existing research. Further discussion about these considerations, and how they may impact on the complexity of a CCS/CCUS method, is at sections 3.5 and 4.1.

CCS/CCUS are emerging and fast-developing technologies. In developing an evidence-based method for these technologies, it will be essential for the Department to draw from a range of sources and engage with experts including from industry and academia. Following standard practice for method development under the ERF, the development of the CCS/CCUS method will involve independent technical expert analysis and review to test the technical accuracy of the method.

3.5. Project Emissions

In calculating abatement, the project emissions standard requires a method to account for all increases in emissions within the project boundary that occur as a consequence of undertaking the project activities. For example, a CCS/CCUS method would need to take into consideration all emissions from implementing the project and carrying out on-going activities. Depending on the design of the method, these may include emissions associated with CO_2 collection, separation, transportation and injection activities, emissions from pre-injection installation or commissioning activities, and on-going post-injection monitoring activities. ERF methods can also consider projects' impacts on emissions in a broader context[5].

3.6. Conservative

This standard requires all estimates, projections and assumptions that have an influence on the abatement calculation to be conservative. In other words, the calculation approach must be cautious and be designed to avoid over-estimation of abatement.

The six offsets integrity standards are often interrelated. The assessment of whether a method satisfies the 'conservative' standard is likely to be affected by other standards. In designing measures to address individual integrity standards, such as additionality or leakage, the design of the approaches and parameters used should err on the conservative side, in particular where there is uncertainty around future outcomes. For example, if there are uncertainties surrounding baseline setting or leakage estimates, the method might need to include a reasonable discount to the abatement calculation to ensure that an overall conservative result is achieved.

Therefore, it is essential to take a flexible and pragmatic approach to the development of CCS/CCUS methods that adhere to the offsets integrity standards, while enabling take-up by industry. Further discussion about the interaction of the integrity standards, in particular the conservative standard, and the scope of the proposed CCS/CCUS method is at sections 4 and 5.

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

This section will examine factors and design choices that will affect the complexity and usability of a CCS/CCUS method. These factors could act as filters to help define the scope of a CCS/CCUS method, with the aim of delivering a practical and useable method that could be developed within a reasonable timeframe.

4.1. Sequestration vs. Avoidance

The ERF framework prescribes that methods can be developed for either 'sequestration' offset projects or 'emissions avoidance' projects. Although methods designed for these two project types are required to satisfy the same offsets integrity standards (discussed in section 3), the two method development pathways involve different design criteria, such as different standard crediting periods and permanence obligations.

Arguably, CCS/CCUS projects exhibit characteristics of both sequestration offsets projects and emissions avoidance projects. This section considers which pathway should be used to develop a CCS/CCUS method.

4.1.1. Sequestration offsets projects

In a general sense, CCS/CCUS projects are sequestration projects as they seek to permanently store CO_2 in geological formations or products. However, the definition of sequestration projects under the ERF framework, as it is currently set in the CFI Act, covers the removal of CO_2 from the atmosphere by sequestering carbon only in *living biomass*, *dead organic matter* or *soil*. The CFI Act

[5] See sections 6.5 and 6.6 of the *ERAC Information Paper: Committee considerations for interpreting the emissions Reductions Fund's Offsets Integrity Standards*, available here: https://publications.industry.goev.au/publications/climate-change/system/files/resources/fb21a1e1-1692-4f74-b71b-9bfcfddc6f85/files/erac-offset-integrity-standards-paper.pdf

was designed to support activities that avoid emissions or sequester emissions in vegetation and soils. It was not designed to accommodate the capture and sequestration of CO_2 in geological formations and mineral carbonates, or the capture and reuse of CO_2 in a way that either sequesters the carbon or displaces emissions from other sources.

With this design intention, the CFI Act incorporates a number of features to facilitate the development, and at the same time ensure the integrity and robustness, of methods supporting land-based sequestration projects. These features include, for example, longer standard crediting periods (25 years), standard discounting of crediting, permanence obligations, reversal notification and carbon maintenance measures, and specific legal and liability requirements. These features were designed to reflect the characteristics and considerations that are unique for biomass, organic matter and soil sequestration activities, and would not be readily adaptable for geological sequestration activities. In particular, 'carbon maintenance obligations', which relate to reversals of sequestration, impose limits on land use in a project area focusing on the surface area of a project. This framework imposes obligations on any owner or occupier of the surface land that may be considered unreasonable to impose for a CCS project that involves storage at least 800 m underground. Eligible interest holder consents are also focused on surface interests in land and could become an unnecessary barrier to participation in ERF CCS projects.

Consequently, to enable the creation of a CCS/CCUS method as a 'sequestration' method, widespread CCS-specific amendments to the CFI Act would be required. Amendments would need to include changing the current definition of 'sequestration projects' or introducing a separate class of projects to cover geological sequestration activities, and changing current supporting mechanisms or creating new ones (such as permanence obligations) to appropriately support the method. Consent requirements would also need to be modified for CCS/CCUS projects. These changes would require an amendment to the CFI Act to be made before a CCS/CCUS ERF method could be made.

Making an ERF method to support CCS/CCUS projects was considered in the *Report of the Expert Panel examining additional sources of low abatement*, released in February 2020[6]. The Expert Panel recommended that *legislative amendments should be pursued to enable a method for carbon capture utilisation and storage*.

While making a CCS/CCUS method as a 'sequestration' method is a feasible option, the need to make wholesale changes to the CFI Act's sequestration provisions, or install an entirely new framework in the CFI Act, could influence the timeline for method development, noting that Act changes would need to be made before a CCS/CCUS method could be completed.

As outlined at the beginning of this section, CCS/CCUS projects exhibit a number of characteristics of 'avoidance' projects, therefore, another option is to develop a CCS/CCUS method under the 'emissions avoidance' pathway. This pathway may be able to be pursued through the standard method development process without the need for framework-level changes to the CFI Act. Under this approach, careful consideration will need to be given to the design of the method to ensure it implements a robust framework for the permanent storage of CO_2. This is because the provisions to ensure permanent storage would be included in the method itself, and not the CFI Act.

[6] The Report of the Expert Panel examining additional sources of low cost abatement can be viewed at https://www.industry.gov.au/data-and-publications/examining-additional-sources-of-low-cost-abatement-expert-panel-report

A CCS/CCUS method developed under the 'emissions avoidance' pathway could achieve the objective of expanding the ERF to cover CCS/CCUS activities, as recommended by the King Review. The rest of this paper will focus on the development of a CCS/CCUS method under the 'emissions avoidance' pathway.

4.1.2. Emissions avoidance projects

CCS/CCUS projects exhibit characteristics of emissions avoidance projects as they reduce emissions to the atmosphere from within the project boundary by either permanently or temporarily storing the CO_2 in geological formations or products. However, there are factors that could impact on the feasibility of developing an 'emissions avoidance' method to support CCS/CCUS projects, and the scope and usability of the method, if made. These are considered below.

Crediting period

A seven year crediting period was adopted as standard for most ERF emissions avoidance projects, recognising that over time emissions reduction activities that receive Government funding to get started will become business as usual. Applying the same crediting period across all projects also ensures that projects from different sectors of the economy are competing and assessed on the same basis in the ERF auction process[7].

The standard seven year crediting period could have a significant impact on the usability of a CCS/CCUS method, given that CCS/CCUS projects typically require significant upfront capital investment, and have long-lasting emissions sequestration capabilities. This could result in projects being denied credits for genuine abatement, which could render projects unviable. A method could stipulate a crediting period that is different from the standard. However, this would need to be justified, and supported with evidence that the implementation of the project activities is not likely to occur under business-as-usual circumstances for the period.

Under the current ERF framework, the ERAC reviews of methods to consider whether crediting periods of projects registered under methods should be extended. Crediting period extension reviews are required to be undertaken for each method before a registered project enters the last 12 months of its crediting period. A method may only have its crediting period extended once. When conducting a crediting period extension review, the ERAC will have regard to whether projects registered under the method continue to result in carbon abatement that is unlikely to occur in the ordinary course of events.

A further element of the crediting period framework that is relevant to a CCS method is the CFI Act's standard approach to commencing crediting periods after project registration. All project proponents must commence their crediting period within 18 months of project registration, and the final investment decision for a project must only occur after project registration.[8] In other words the maximum extension of a crediting period start date is 18 months after project registration.

The Department is keen to understand the implications of the standard 18 month extension period on CCS/CCUS projects' viability and hear suggestions as how these implications could be managed.

[7] More information about ERF contract and auction process is available here: http://www.cleanenergyregulator.gov.au/ERF/Want-to-participate-in-the-Emissions-Reduction-Fund/Step-2-Contracts-and-auctions/participating-in-an-auction.

[8] More information on these requirements is available here: http://www.cleanenergyregulator.gov.au/ERF/Want-to-participate-in-the-Emissions-Reduction-Fund/Planning-a-project/Eligibility-and-newness

Permanence obligations

Unlike the 'sequestration offsets' option of developing a method, a CCS/CCUS 'emissions avoidance' method would need to build into the method sufficient measures to ensure permanence issues are appropriately addressed. For example, the CFI Act requires all ERF carbon sequestration projects to maintain carbon stores for either a 100-year or a 25-year permanence period. The Act applies a 5% discount to the number of credits issued to all sequestration offsets projects (a risk of reversal buffer) and an additional 20% discount to projects electing a 25-year permanence period. The discounts reflect the potential cost to the Government of replacing lost carbon stores, where vegetation on project land is not maintained during or after the end of their permanence period. The CFI Act also includes other supporting measures, such as reversal notification and carbon maintenance measures, and specific legal and liability requirements, to ensure a reasonable level of assurance of the permanence of project results. However, presently there are no equivalent built-in measures in the CFI Act that would apply to a CCS/CCUS method that is developed as an 'emissions avoidance' method.

Under the current ERF framework, methods could include an extended accounting period, which begins immediately after the end of the crediting period. For example, a CCS/CCUS method could have a standard ten year crediting period and a twenty year extended accounting period. The method could prescribe that for the crediting period (including an extension, if made) the project proponent would get X per cent of the carbon abatement calculated in accordance with the method. After the crediting period, the proponent would receive the remainder of the credits, which would be spread out over the extended accounting period, subject to satisfying relevant requirements, e.g. on-going monitoring reporting and proof of no leakage detected. An additional 'risk of reversal' buffer could also be used, as is the case with land-based sequestration projects.

To a certain extent, this approach could create a similar effect to that provided by the 'sequestration' method framework. However, it should be noted that the current 'emissions avoidance' method framework does not facilitate the use of a credit relinquishment mechanism as an insurance policy to deal with circumstances such as the occurrence of physical leakage of stored CO_2.

Existing legislative frameworks for ensuring the permanence of injected carbon, such as those applying under the Commonwealth *Offshore Petroleum and Greenhouse Gas Storage Act 2006*, will also be a relevant consideration in demonstrating the permanence of abatement. It is likely that having relevant licences and approvals under the relevant Commonwealth, state and territory legislation will be necessary to be an eligible offset project under the method. Information reported under these regimes would also be expected to be shared with the CER for compliance purposes.

Stakeholder comment
Stakeholder views are sought on:

- whether CCS/CCUS methods should be developed as 'sequestration' or 'emissions avoidance' methods;
- how the standard 18 month maximum crediting period start date extension might impact on CCS/CCUS projects' viability;
    - how these impacts could be mitigated;
- factors that should be considered in deciding the length of suitable crediting periods and extended accounting periods for CCS/CCUS methods;
- an 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;
- how this balance may vary between different CCS/CCUS technologies and activities.

4.2. Technology/activity neutral (one size fits all) vs. technology/activity specific

A typical factor that would have a direct and significant impact on the design and complexity of a method is whether a technology/activity neutral or a technology/activity specific approach is used.

4.2.1. Technology/activity neutral—one size fits all

Under this lens, sitting at one end of the spectrum is a one-size-fits-all CCS/CCUS method that supports all CCS/CCUS projects regardless of what separation, transport and injection/storage technologies are used and what activities are involved. The primary advantage of this approach is its broad coverage, which would provide an equal opportunity to all technologies and industrial sectors to participate in the scheme from the commencement of the method. However, broad coverage could also present major challenges to designing and using the method. These challenges stem from the wide range of issues and divergent technical, commercial and financial characteristics of different technologies and sectors that would need to be accommodated by a technology/activity neutral method, in particular the consideration of additionality and leakage as discussed in section 3. The following are some examples of these challenges:

- the commercial readiness and financial viability of deploying CCS/CCUS technologies in different sectors varies significantly;
- the up-stream impact on the emissions intensity of production could vary between facilities, for example it could differ when installing CO_2 collection and separation mechanisms in a coal-fired generation plant and an oil and gas facility;
- costs and permanence considerations associated with sequestering CO_2 in geological formations and building products could be very different; and
- different types of CCS/CCUS projects would also have very different project boundaries—which, to accommodate in a one-size-fits-all method, may require a complex framework that could create coverage risks for some project types.

Experience gained from the development and recent review of the Facilities Method, which uses a one-size-fits-all approach, shows that such an approach would likely compromise the useability of the method for two reasons. First, the method would likely be complicated because it would need to include rules and restrictions to ensure that, at the method level, the offsets integrity standards would be met for all possible project activities in all sectors and all technology types. Second, an omnibus approach to coverage often necessitates the use of a ‘lowest common denominator’ or blunt approach in designing requirements and discounts. This in most cases produces a much more conservative outcome when compared to the actual result delivered by any specific project. For example, if a CCS/CCUS method is designed to support a wide range of sectors, a more stringent discount to the abatement calculation might need to be used to address the ‘weakest link’ of the sectors covered in terms of additionality and leakage risks.

4.2.2. Technology/activity specific

Sitting at the other end of the spectrum is a CCS/CCUS method that is designed to support a specific technology and/or a narrowly defined activity. In contrast to the issues discussed above for the one-size-fits-all approach, this approach allows the method design to focus on the unique issues and characteristics of the technology/activity that is intended to be covered by the method. Tailor-made measures could be developed to address potential issues surrounding compliance with the integrity standards for the more narrowly-targeted project types allowed under the method. Hence, the method would be more straightforward to develop and easier to apply to projects. This approach is also likely to enable an abatement calculation that is more reflective of the actual result achieved by the project. However, this approach means that multiple methods would need to be developed to cover the full range of CCS/CCUS projects. Care would need to be taken to ensure that consistent approaches are used for different technologies and/or activities.

The ERF method development prioritisation approach[9] could be used as a reference to help decide which CCS/CCUS technologies/activities should be prioritised for method development. Considerations could include:

- whether the technology/activity is proven and close to being commercially ready;
- the potential uptake and likely volume of abatement;
- availability of existing frameworks to support the measurement and verification of the relevant emissions;
- technical and legal risks, in particular those associated with permanence issues.

Should a technology/activity specific approach be used, the Department will develop, in consultation with industry and other stakeholders, a timeline/pathway for extending coverage to technologies/activities that are not included in the initial method development process. The timeline/pathway could also consider establishing new CCS/CCUS methods where that is more efficient.

[9] More information about the ERF method development prioritisation could be found at https://publications.industry.gov.au/publications/climate-change/climate-change/government/emissions-reduction-fund/methods/method-development.html

Stakeholder comment
Stakeholder views are sought on:

- whether there are other factors that should be considered in prioritising CCS/CCUS technologies/activities for method development;
- 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;
- 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.
- factors that need to be considered in the development of a timeline/pathway for extending coverage to other technologies/activities.

4.2.3. Modular approach vs. discrete methods

Consideration could be given to developing the method with a modular framework. Under a modular approach, the method could initially target one or a limited set of CCS/CCUS activities, with scope to add new modules in the future to cover additional types of CCS/CCUS. The advantage of a modular approach is that the initial method could include elements (such as an approach to geological storage) that would apply to many other types of CCS that could be added in the future. For example, the initial method(s) could focus on activities such as CCS from oil and gas facilities and CCS from electricity generation, with the potential for a module for CCS from specific industrial processes to be considered by ERAC in a follow-on phase of CCS/CCUS method development.

The method could be designed so that provisions that deal with storage in geological formations could be expanded in the future to cover storage in products or use in other applications. Any expansion of the method through the addition of new modules would be subject to the method development process and ERAC review.

Although a modular approach offers a certain level of flexibility and allows gradual growth of the method's coverage, a high level method structure and concept would still need to be fixed when the method is first made. For example, the high level abatement calculation concept, and basic approach for addressing leakage issues, would need to be decided at the beginning of the process. Factors such as these need to be set so that the structure and content expected from each module could be clearly articulated in the method. A modular approach to method development may require more time and development resources relative to a technology/activity specific approach because consideration would need to be given to ensuring that the method 'shell' could accommodate new modules in the future.

An alternative to a modular method is to develop new, discrete ERF methods for additional forms of CCS in the future. This approach may be more suitable for forms of CCS that share fewer characteristics with the forms of CCS covered by the first ERF CCS method. As an example, if the first method covers CCS from oil and gas, an additional module for CCS from the fertiliser industry could be added using the modular approach at a later date because CCS from the fertiliser industry may use the same transport and injection approaches used in the oil and gas sector. The only additional module needed to support CCS in the fertiliser sector would be one that deals with separation. In contrast, CCUS could potentially be better supported through a new standalone method because it uses a different separation *and* storage approach. The new standalone method could, where possible, borrow principles and approaches from the first method, streamlining the second method development process.

The future coverage of additional forms of CCS could be implemented in whichever way is most efficient (through adding a new module to the first method or through developing a new method) taking into account the characteristics of the specific form of CCS.

Stakeholder comment
Stakeholder views are sought on:

- 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; and
- whether certain types or groups of CCS/CCUS technologies or activities would be better supported by one approach over other approaches.

4.3. Cradle to well vs. Injection-well-focused

This section considers the approach to setting the project boundary and the use of different approaches in calculating abatement. The section examines two possible approaches, which are largely based on common approaches that are used in other CCS/CCUS measuring and reporting frameworks. The discussion focuses on high-level method design concept issues, and the advantages and challenges of adapting these approaches under the ERF framework.

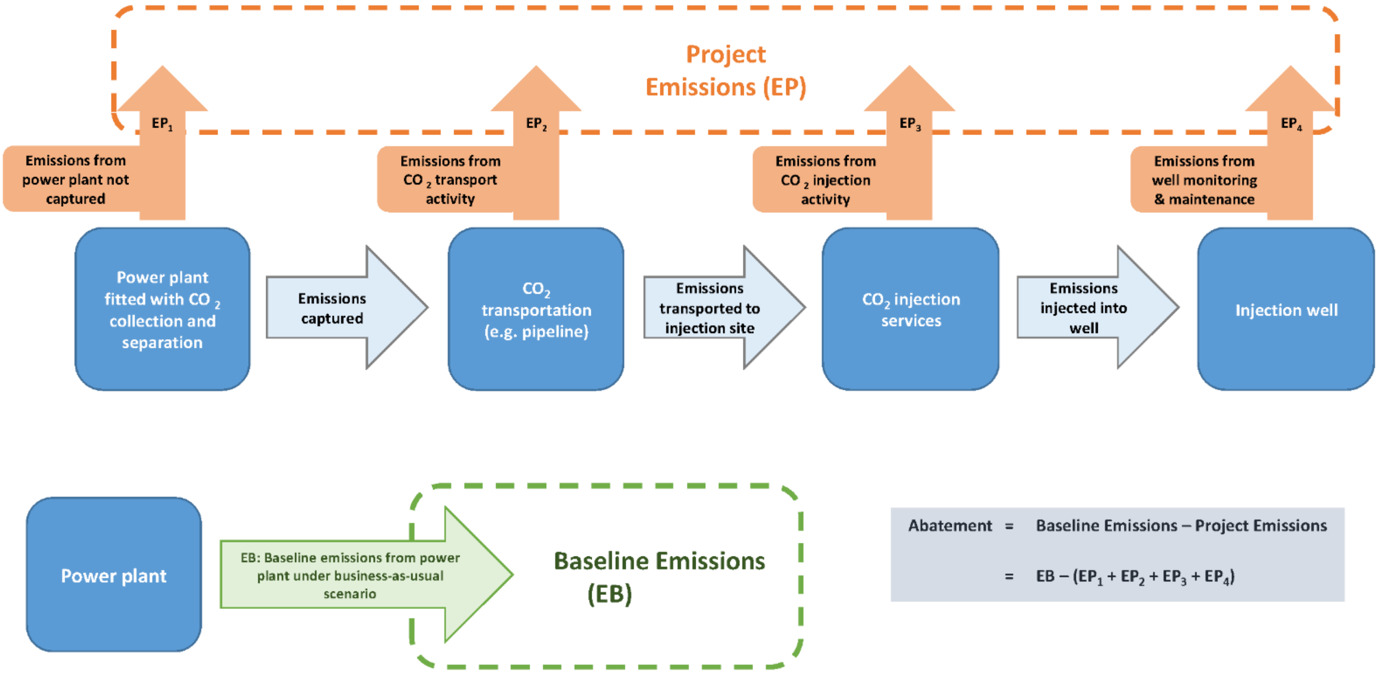
4.3.1. Cradle to well

In a cradle-to-well approach the project boundary would cover the full separation to injection process, i.e. begin where emissions are generated and end where they are sequestered in the well. The project boundary would extend from the emissions source (the facility that generates emissions as a result of their operation) to the emissions injector (the facility that undertakes the emissions injection activity), and all other entities in-between (e.g. facilities that undertake activities such as CO_2 collection, separation, transportation, etc).

Using a power plant CCS retrofitting project as an example, the project boundary would include the existing power plant and all the new additional units, plants and infrastructure (e.g. pipelines or truck tankers) supporting the CCS activities, including the injection site and on-going monitoring devices. The baseline scenario would be that the existing power plant continues to generate in a business-as-usual manner (i.e. without the CCS retrofit). That is, the baseline emissions would be the amount of emissions that are expected to be released under conditions that would have occurred should the CCS project not have been implemented.

Figure 1 shows the calculation approach for a cradle-to-well method.

Figure 1: Cradle-to-well calculation approach



A typical approach to estimate the baseline emissions level is the standards-based approach, discussed in section 3.1.3. The baseline emissions are calculated based on production variables and their corresponding performance standards, usually expressed as an emissions intensity metric (i.e. tonnes of CO_2 per unit of production). In a power plant, this would be the plant's emissions intensity expressed as tonnes CO_2/megawatt hour. In this case, baseline emissions would be calculated by multiplying the actual megawatt hours (MWhs) delivered to the grid in the project period (net MWh) multiplied by the emissions intensity value.

The selection of suitable production variables and the determination of appropriate corresponding emissions intensity values could be based on the site-specific, sectoral or overseas performance standards. Experience from other programs, such as the Safeguard Mechanism, in developing production variables and emission intensity values could be drawn on in the method development process. However, the differences between the underpinning objectives of the Safeguard Mechanism and the offsets integrity standards set out under the ERF would need to be acknowledged and their implications considered in designing a baseline setting mechanism for CCS/CCUS methods. Other factors, such as business-as-usual improvement or natural fluctuation of the emissions from the primary production activities, also need to be considered to ensure the baseline setting mechanism would not systematically over-credit abatement. Another potential limitation of this baseline setting approach is that greenfield projects might not be readily supported because of their lack of historical data.

For project emissions, all emissions from within the project boundary would need to be covered. Subject to the business and operational structures of the entities covered within the project boundary, there would be a strong synergy between the data that are already required to be measured and reported under the NGERS and the calculation of the project emissions under a cradle-to-well approach. For example, if all of the relevant entities are reporting under NGERS, the project emissions could be easily established by adding up the relevant NGERS emissions data. The abatement would be the difference between the baseline established using appropriate production variables and emissions intensity values, and the project emissions calculated by adding up all relevant reported NGERS emissions.

The main advantage of a cradle-to-well approach is that issues such as emissions associated with CO_2 collection and separation processes, as well as impacts on upstream production activities and emissions from the on-going monitoring activities would be internalised and appropriately accounted for within the emissions envelope established by the project boundary. This could potentially reduce the complexity of the method, but would require individual facilities involved in any hub and spoke arrangement to establish their own contractual arrangements to apportion the resulting ACCUs among the various entities involved in the project.

Stakeholder comment

Stakeholder views are sought on:

- 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.

A downside of the cradle-to-well approach is that it would work best if the method could rely on NGERs to capture all project emissions, i.e. if all involved entities are reporting under NGERS. If the method scope is intended to cover non-NGERS entities or activities that are not covered by the existing NGERs measurement methodologies, more specific measurement and reporting requirements would need to be developed and included in the method to identify and account for the associated emissions. Furthermore, in selecting appropriate production variables and corresponding emissions intensity values, a conservative approach would be required to ensure the offsets integrity standards are met. For example, in the Facilities method, the lowest emissions intensity in a reference period (in most cases 4 to 6 years before the commencement of the project) is used as the basis for calculating the baseline emissions. A further issue is that some facilities, including in the oil and gas sector, produce many outputs, which would require the use of a number of production variables for each project, increasing the complexity of method development and project reporting and accounting.

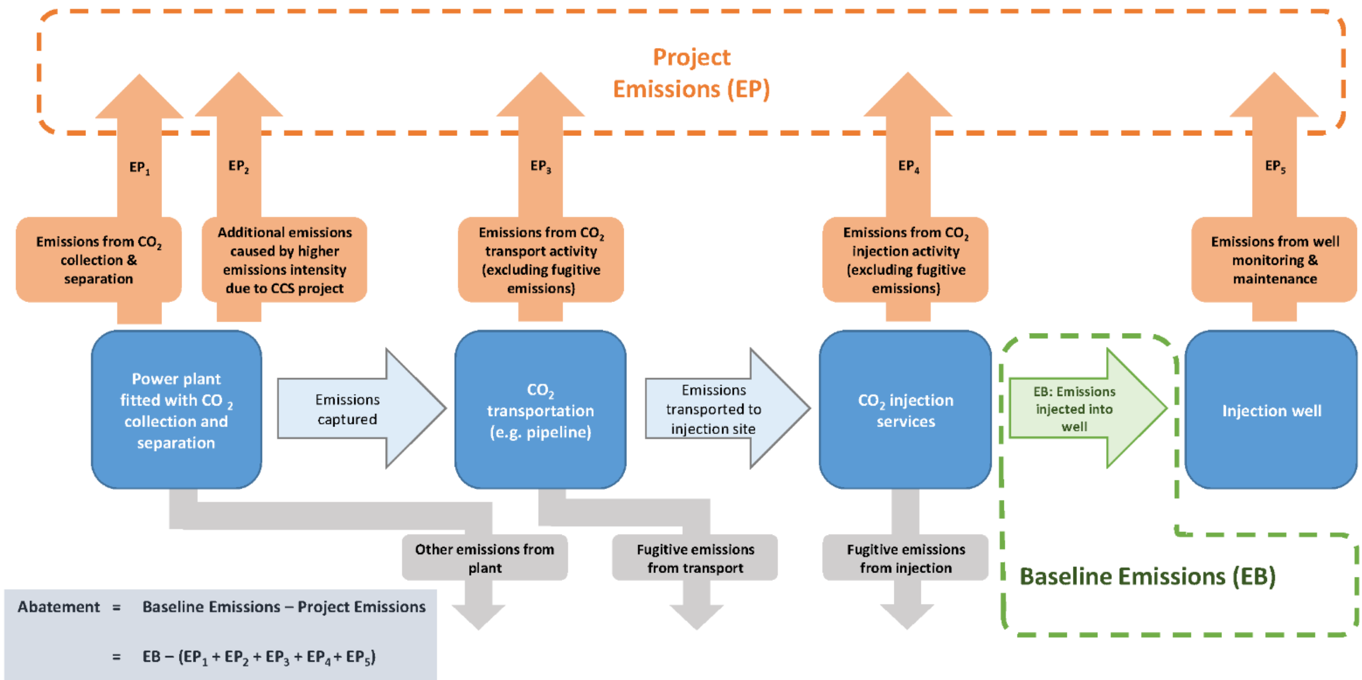
4.3.2. Injection-well-focused

An 'injection-well-focused' approach focuses on the actual amount of CO_2 that is sequestered, and uses it as a reference baseline, i.e. the starting point for calculating the net abatement from a project. Usually this amount is the emissions measured directly upstream of the injection wellheads in the project. This represents the portion of the emissions from the emitter that are prevented from being released (i.e. emissions avoidance) to the atmosphere as a result of the project. To calculate the net abatement from the project, the corresponding project emissions would need to be identified and subtracted from the baseline. These project emissions would include emissions associated with the project activities that are undertaken to enable sequestration, typically including CO_2 collection, separation, transportation, injection and on-going monitoring. The business-as-usual operating emissions of the relevant facilities in the absence of the project, and with the project, would not be factored into the baseline and project emissions calculations. Abatement would be calculated only on the quantity of CO_2 injected (the baseline emissions) and the additional quantity of CO_2-e generated from processes needed to implement the CCS project (the project emissions). The injection-well-focused calculation approach relies more on actual measurement in the project, whereas the cradle-to-well approach relies on modelling baseline emissions.

Effectively, the project boundary starts from the point of CO_2 collection and separation, and unlike the cradle-to-well approach, it does not cover the primary production activities of the emitter, e.g. grinding and milling processes in a cement facility. Due to this, to calculate the project emissions, the method might not be able to rely directly on the emissions data reported under NGERS. For example, the method would need to contain an appropriate built-in mechanism to unpack and identify the relevant emissions associated with running the devices supporting the CO_2 collection and separation processes. These emissions might be wrapped up and reported under an emissions source that also covers non-CCS/CCUS related activities in the facility (e.g. grinding and milling as per the above cement example). The method would also need to include measures to address the impact of the CCS/CCUS activities on the emissions intensity of the primary production activities of the emitter, e.g. the change in the coal consumption rate in a power plant, which is not internalised and accounted for in the emissions envelop under this approach.

Figure 2 shows the calculation approach for an injection-well-focused method.

Figure 2: Injection well-focused calculation approach



As discussed in section 4.2, the scope width of the method would directly interact with how difficult it would be to develop appropriate measures to address the above discussed issues. Theoretically, an 'injection-well-focused' approach could incorporate the use of a hub and spoke CCS/CCUS operating model. However this would add additional complexity to the design of the method, in particular in cases where an injection hub is used for emissions from a mix of industrial processes (e.g. electricity generation and chemical production). Therefore, supporting hub and spoke networks may only be practical initially if a narrow range of technologies and activities are targeted under an injection-well-focused method. Additional modules or methods may be needed to support hub and spoke CCS projects that involve capture at facilities that undertake different activities (such as fertiliser production, steel manufacturing and cement production). Should the above discussed issues be appropriately dealt with and mechanisms be developed to accurately determine project emissions, the use of the actual CO_2 injection amount as the baseline reference could potentially result in a more accurate estimation of net abatement, while ensuring the conservativeness of the method.

Stakeholder comment

Stakeholder views are sought on:

- whether CCS could best be supported under a cradle-to-well based method or an injection-well-focused method; and
- 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 CO_2 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.

4.4. CCS vs. CCUS

At a high level, CCS and CCUS projects share some similarities, particularly in relation to the CO_2 collection, separation and transportation processes. However, from a method development perspective, there are some fundamental differences in their technical and commercial characteristics that would present very different challenges. These challenges would need to be dealt with using different approaches. Differences between the two types of projects may mean that it is not practical to design a method that would support both types. It could be more effective and efficient to develop separate and targeted methods to support CCS or CCUS projects when the respective technological and commercial conditions are mature and appropriate in the ERF context. The following are a few examples of the relevant differences between CCS and CCUS.

Technological considerations

- The science underpinning the storage of CO_2 in geological formations differs from that underpinning storage in products. Therefore, different approaches would be needed to measure and verify the associated emissions, to address leakage and permanence issues, and to substantiate the required level of robustness and conservativeness under the ERF framework.
- The availability and maturity of existing frameworks that methods could rely on to develop the measuring and reporting requirements and permanence assurance measures are significantly different for these two types of projects. For example, the current NGERs framework does not cover CCUS.

Commercial considerations

- Costs and benefits involved could be substantially different for these two types of projects. For example, the co-benefits, in particular financial co-benefits, and the cost structure for CCUS projects are likely to be different from their CCS counterparts, and so are the implications on project additionality and commercial readiness.
- The legal issues surrounding project safety and long term liability for CCUS projects are not the same as those for CCS projects.

Similar to the discussion in section 4.2.2, should specific CCS or CCUS technologies/activities be identified as the initial focus of the method development process, the Department will develop, with input from industry and business stakeholders, a timeline/pathway for extending coverage to technologies/activities that are not initially included in the process.

Stakeholder comment

Stakeholder views and inputs are sought on:

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

4.5. Prescriptive vs. project specific method requirements

As discussed in section 3, the ERAC must be satisfied that an ERF method meets all of the six offsets integrity standards at the *method-level* before the Minister can make the method into law. In other words, a method must include sufficient measures and requirements to provide certainty that all projects that could use the method, and the credits subsequently generated as a result of project activities, would meet all the standards. To achieve this, methods are typically prescriptive and contain all the required details to accurately calculate abatement. Should external bodies, rules, standards or databases be referred to in methods, they must be well established and proven, and be able to support and complement the measures and requirements prescribed in the method. This ensures that, as a whole, the method meets the offsets integrity standards (as assessed by ERAC).

In some circumstances, the complexity of a method could be reduced if a project-specific approach is used to deal with certain technical details that are unique to individual projects. In some cases, the uniqueness of the technical or operational characteristics of the projects covered by a method could render it difficult to prescribe detailed measures or requirements at a *method-level*. Under these circumstances, it could be more practical to consider allowing project-specific details to be assessed and approved as part of the project approval process (undertaken by the Clean Energy Regulator). However, the method still needs to incorporate sufficient high-level principles and rules, including assessment and approval processes, to ensure the method on its own, i.e. without the project-specific details, would meet the level of robustness and conservativeness that is required under the offsets integrity standards.

All CCS/CCUS projects are likely to possess unique characteristics as discussed above. In particular, there are two examples worth examining in relation to the suitability of a project-specific approach:

- The technical and operational issues surrounding capturing CO_2 from different industrial processes vary significantly. CCS/CCUS one area where new technologies are emerging and site-specific solutions are the common development direction.
- Injection wells and reservoirs have their own unique geological features. There is significant variation in the behaviour of stored CO_2 depending on these features. Features may vary in their shape and size, rock type, porosity, likely fluid flow pathways, and whether the CO_2 is stored in a saline aquifer or a depleted oil and gas field, amongst other things. These

variations could have very different implications on the permanence of the CO_2 stored, and consequently what on-going-monitoring measures would be appropriate.

While the use of a project-specific approach could potentially reduce the complexity of a method, it would create an additional workload for the approval authority (e.g. the CER). The extent of this additional workload would depend on factors such as:

- The amount and complexity of the details that are required to be assessed;
- The clarity and definiteness of the assessment principles; and
- The expected number of projects.

Using this approach could also impose some risks on project proponents:

- Proponents would need to undertake costly investigations and planning without having the certainty of the project being approved.
- If the technical or operating details submitted at the project application stage are changed subsequent to project approval, there could be a risk of the original project approval being revoked.
- The assessment of the project-specific details could significantly extend the project registration timeframe.

Therefore, the use of a project-specific approach in designing a method needs to be carefully considered so as to strike the right balance between simplifying the method and ensuring it is practical and usable.

5. Design options

To balance the issues application of the offsets integrity standards in section 3 and the factors raised in section 4, the Department has identified three design options as a first step in developing ERF methods supporting CCS/CCUS activities. These method design options are intended to act as models that stakeholders can react to in their submissions on this paper, with the aim of mapping out a method development process that could lead to the timely completion of a method that is practical and could be used to support commercially ready CCS/CCUS activities.

The three options and their advantages and challenges are listed in the following table.

Stakeholder comment

Stakeholder views and inputs are sought on:

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

	Option	Coverage	Abatement calculation	Advantages	Challenges	Remarks
1	**Technology-neutral/ cradle-to-well/ CCS**	Facilities reporting under the NGERs.	- Baseline determined using production variables and emissions intensity values. - Project emissions determined by using relevant data reported under NGERs. - Abatement capped at the total emissions injected.	- Wider coverage. - Could build on NGERs and Safeguard Mechanism. - No need to separately deal with impacts on emissions from primary/upstream production activities.	- 'Lowest common denominator' effect – a generally conservative approach would be required because of the need to accommodate a wide range of activities. - Significant effort required to examine all possible activities, in particular regarding addressing additionality and leakage issues. - Could potentially use the 'project specific' or 'modular' approach to deal with some technical details to simplify the method.	- Coverage would still need to align with NGERs, e.g. cannot initially support CCU, transportation of CO_2 by road or sea, or direct air capture.
2	**Technology-specific/ cradle-to-well/ CCS**	Targeted sector(s), with scope to expand through additional module/ methods.	- Baseline determined using production variables and emissions intensity values. - Project emissions determined by using relevant data reported under NGERs. - Abatement capped at the total emissions injected.	- Allow more focused effort on a targeted number of possible activities, and avoids the 'lowest common denominator' effect. - Build on NGERs and Safeguard Mechanism; - Somewhat simple calculation; - No need to separately deal with impacts on emissions from primary/upstream production activities.	- A conservative approach would be required when using historical or market data, e.g. referencing lower emissions intensity values as per the Facilities method. - Cover narrowly targeted activities, which need to be identified based on additionality and commercial readiness. - Multiple methods (or modules under a single method) would be required to cover a large range of sectors.	- The targeted activities must be covered by NGERs, i.e. cannot initially be CCU, transportation of CO_2 by road or sea, or direct air capture.

3	**Technology-specific/ injection-well-focused/ CCS**	Targeted sector(s), with scope to expand through additional modules/ methods.	- Baseline determined by direct measurement of the amount of CO_2 injected. - Project emissions determined by adding the emissions from collection, separation, transportation, injection and monitoring processes calculated using rules specified in the method.	- More reflective/accurate abatement calculation because of the calculation approach. - No need to consider impact of business-as-usual improvement or natural fluctuation of emissions from primary production activities. This is especially important for sectors that experience variability in emissions intensity year to year. - Allow more focused effort on a small number of possible activities, potentially leading to faster method design. - Easier to develop more targeted measures for dealing with additionality and leakage issues (e.g. impact on emissions from primary/upstream production activities).	- Cover narrowly targeted activities, which need to be identified based on additionality and commercial readiness. - Method needs to include measurement and reporting requirements for project emissions. - Unpacking the emissions associated with CO_2 collection and separation processes, and the impact on the emissions from primary/upstream production could be complicated (e.g. the change to the coal consumption rate in a power plant because of the CCS project).	- This is the approach used in the Alberta protocol. - This approach is likely to result in a more straightforward calculation of abatement. - Abatement calculation would likely still need to rely on the NGERs Measurement Determination.

6. Recommended design approach

Balancing all the issues involved and their potential implications on the complexity and time required to develop a method, the Department recommends either option 2 or option 3, both of which are technology/activity specific. The rationale for this recommendation is as follows:

- The 'lowest common denominator' effect would likely result in the number of credits generated under a technology/activity neutral CCS/CCUS method being lower than the actual abatement delivered by a project. As capital costs are one of the most significant barriers to CCS/CCUS projects, limiting discounting of crediting where possible is desirable.
- The need to examine a much wider range of possible technologies/activities and develop measures that sufficiently cover them all would significantly increase the time and resources required to develop a technology/activity neutral CCS/CCUS method, both for the Government and for the technical experts from industry who will assist in method development. A technology/activity neutral CCS/CCUS method would also be more complex and difficult for businesses to use.
- Regarding whether a 'cradle-to-well' or 'injection-well-focused' approach should be used, the Department notes that they both have their own advantages and challenges. The suitability of these approaches for different types of technologies/activities depends on a number of factors. The most important factor is how difficult it would be to unpack the impacts on the primary production activities, e.g. changes in the emissions intensities of these activities as a result of the project. If this is difficult, the 'cradle-to-well' approach would be the better of the two options because the impacts would be internalised and accounted for. Otherwise, the 'injection-well-focused' approach would be preferred because it could potentially support abatement calculations that are more reflective of the actual abatement delivered by the project. The 'injection-well-focused' approach would also address the issue of some elements of CCS/CCUS projects (such as pipeline transport) not being undertaken by NGER reporting facilities.
- Based on the Department's preliminary research, CCS is generally more developed and commercially viable than CCUS. Therefore, it is recommended that the initial method development will focus on CCS technologies and activities.
- Based on the Department's preliminary research, oil and gas projects could be a suitable candidate for the development of a CCU/CCUS method in the first instance for the following reasons:
    - they are technologically viable and closer to commercial readiness, with 10 of the 21 existing large-scale CCS facilities in operation worldwide today being associated with natural gas processing plants;
    - Sectors where a high concentration CO_2 stream is already separated as part of the existing facilities' processes face much lower cost barriers in establishing CCS projects. Projects in these sectors are therefore more likely to become viable if covered by the ERF. Of the sectors that already produce a high concentration CO_2 stream, gas processing appears to hold the highest potential for delivering low-cost, high volume emissions reductions that can be used to meet Australia's international emissions reduction commitments;
    - the financial barrier is neither too low that projects could/might happen without the ERF incentive, nor too high that the ERF incentive would not be likely to be a deciding factor for the implementation of the project;
    - the relevant technologies and activities are well supported by Commonwealth and State CCS and emissions accounting frameworks; and

- lessons learnt from developing a method supporting oil and gas projects would be useful for future expansion or development of new methods to cover technologies and activities with more complicated technical and commercial issues. Coverage of additional forms of CCS/CCUS in the future would be expected to be more streamlined because they could build on the framework of the initial method.

- CCS from electricity generation could also be considered as a priority for method development. This is because of the scale of potential abatement from CCS associated with electricity generation, and the potential for CCS to occur in hub and spoke arrangements where CO_2 may be sourced from a number of facilities, including gas processing facilities and electricity generators located in the same region. Australia is also uniquely placed to deliver CCS from electricity generation because of its significant geological storage resources and because of the proximity of some of those resources to existing electricity generators. The Surat and Gippsland Basins are two relevant examples of potential geological storage sites that are co-located with existing electricity generation facilities. Worldwide, there are 16 electricity generation CCS projects that are at the early development and advanced development stages. The Department is interested in views on the viability and timelines for CCS associated with electricity generation in the Australian context, as well as the technologies most likely to be used for CCS in the electricity generation sector.
- CCS/CCUS from other processes, such as fertilizer production, bioethanol production, chemical production, cement manufacturing and steel production also represent abatement opportunities in the Australian context. Stakeholder views are sought on the best approach to cover technologies in these and other sectors, including how any initial method(s) can be designed to accommodate an expanding set of activities over time.

A timeline/pathway could be developed to set out a process for developing modules or methods to cover other technologies and activities that are not covered by the initial method development process. Ongoing method development to cover an increasing number of technologies over time will help to ensure the ERF can support CCS projects that occur in hub and spoke arrangements, where CO_2 is sourced from a number of locations/industrial facilities.

Stakeholder comment

Stakeholder views and inputs are sought on:

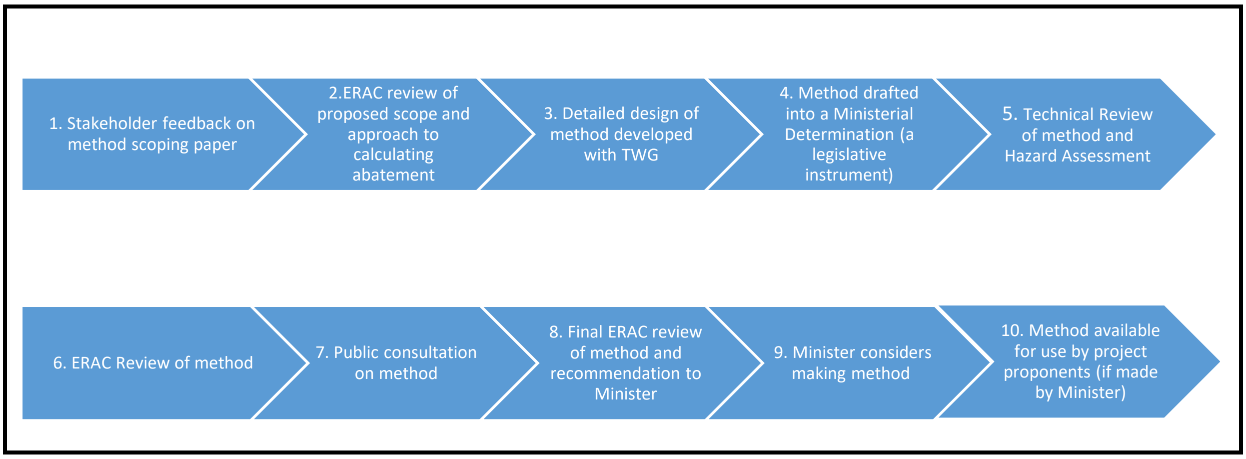
- What activities/sectors should be prioritised for coverage under the method(s) in the first instance?
- Whether option 2 or option 3 should be pursued as the preferred abatement calculation approach.
- The approach of establishing a timeline/pathway for expanding coverage of CCS/CCUS activities over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

7. Next steps

Following stakeholder feedback on the proposals in this paper, the Department will seek ERAC's views on the scope of the proposed method and its approach to calculating abatement. The Department will then work with a Technical Working Group of industry experts to design the detailed operation of the method.

High-level method development steps are set out in Figure 3.

Figure 3: Method development steps



Attachment A: Existing carbon capture and storage protocols and frameworks

Framework or legislation name	Framework Type	Jurisdiction	Link
Barrow Island Act 2003	Legislation	WA	https://www.legislation.wa.gov.au/legislation/statutes.nsf/main_mrtitle_76_homepage.html
Offshore Petroleum and Greenhouse Gas Storage Act 2006	Legislation	Federal (offshore >3 nautical miles)	https://www.legislation.gov.au/Details/C2020C00174
Greenhouse Gas Storage Act 2009	Legislation	QLD	https://www.legislation.qld.gov.au/view/pdf/inforce/2016-07-01/act-2009-003
Petroleum Act 2000	Legislation	SA	https://www.legislation.sa.gov.au/LZ/C/A/PETROLEUM%20ACT%202000.aspx
Greenhouse Gas Geological Sequestration Act 2008 (onshore)	Legislation	VIC	https://www.legislation.vic.gov.au/in-force/acts/greenhouse-gas-geological-sequestration-act-2008/013
Offshore Petroleum and Greenhouse Gas Storage Act 2010	Legislation	VIC	https://www.legislation.vic.gov.au/in-force/acts/offshore-petroleum-and-greenhouse-gas-storage-act-2010/014
National Greenhouse and Energy Reporting (Measurement) Determination 2008	Legislation	Federal	https://www.legislation.gov.au/Details/F2019C00553 (Division 1.2.3)
2006 IPCC Guidelines for National Greenhouse Gas Inventories and 2019 Refinement – Volume 2, Chapter 5 CARBON DIOXIDE TRANSPORT, INJECTION AND GEOLOGICAL STORAGE	Guidelines	International	https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_5_Ch5_CCS.pdf
International Organization for Standardization 14064-2:2019 Greenhouse gases — Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements	Guidelines	International	https://www.iso.org/standard/66454.html
EU Directive 2009/31/EC	Legislation	European Union	https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0114:0135:EN:PDF

Subpart RR – Geologic Sequestration of Carbon Dioxide	Requirements	USA - Federal	https://www.epa.gov/ghgreporting/subpart-rr-geologic-sequestration-carbon-dioxide
UNFCCC Decision 10/CMP.7 (2011)	Requirements	International	https://unfccc.int/resource/docs/2011/cmp7/eng/10a02.pdf (Pg. 13)
Canadian Standards Association Z741-12 - Geological Storage Of Carbon Dioxide	Guidelines	Canada & USA	https://infostore.saiglobal.com/en-us/Standards/CSA-Z741-2012-361582_SAIG_CSA_CSA_2662628/
Center for Climate and Energy Solutions: Greenhouse Gas Accounting Framework for Carbon Capture and Storage (CCS) Projects	Guidelines	International	https://www.c2es.org/document/greenhouse-gas-accounting-framework-for-carbon-capture-and-storage-projects/
American Carbon Registry Methodology: Greenhouse Gas Emissions Reduction Methodology for Carbon Capture and Storage Projects	Requirements	USA	https://americancarbonregistry.org/carbon-accounting/standards-methodologies/carbon-capture-and-storage-in-oil-and-gas-reservoirs/acr-ccs-methodology-v1-0-final.pdf
Alberta's Quantification Protocol: Quantification Protocol for CO2 Capture and Permanent Storage in Deep Saline Aquifers Protocol	Legislation	Alberta, Canada	https://open.alberta.ca/publications/9780778572213
California CCS Protocol: Carbon Capture and Sequestration Protocol Under the Low Carbon Fuel Standard	Legislation	California, USA	https://ww2.arb.ca.gov/resources/documents/carbon-capture-and-sequestration-protocol-under-low-carbon-fuel-standard