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The ERF's Human-induced Regeneration (HIR): What the Beare and Chambers Report Really Found and a Critique of its Method

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Executive summary

The Emissions Reduction Fund (ERF) is the centre-piece of the Australian Government's climate policy. It was first introduced in 2014 and is comprised of three main elements: a carbon offset crediting scheme, which issues Australian carbon credit units (ACCUs) to projects that abate emissions; a purchasing scheme, whereby the Clean Energy Regulator (on behalf of the Australian Government) voluntarily purchases ACCUs from eligible offset projects; and the 'Safeguard Mechanism', which imposes emission obligations on designated large facilities that can be met through the relinquishment of ACCUs.

For the ERF to serve its purpose of reducing emissions to help Australia meet its international climate change obligations, ACCUs must have environmental integrity. While there is a need to balance integrity and efficiency, to the extent possible, ACCUs should represent 1 tonne of carbon dioxide equivalent (CO_2-e) avoided or sequestered. This principle is embodied in the legislation that underpins the ERF, the *Carbon Credits (Carbon Farming Initiative) Act 2011* (CFI Act), which requires all methods for generating ACCUs to meet six offsets integrity standards, including that the projects covered by the methods should result in abatement that is 'unlikely to occur in the ordinary course of business (disregarding the effects of this Act)', the methods should be 'supported by clear and convincing evidence', and the estimates, projections and assumptions in the methods 'should be conservative'.

To date, the most popular ERF method has been Human-induced Regeneration (HIR), which allows landholders to earn ACCUs for the regeneration of native forests. As of November 2021, HIR projects accounted for 32% of all registered ERF projects, 27% of all issued Australian carbon credit units (ACCUs) and more than 50% of all ACCUs contracted through the ERF purchasing scheme, worth approximately $1.5-1.6 billion.

Three integrity concerns have been raised about the HIR method and its administration.

- Crediting of ineligible areas. The suggestion that HIR projects have been allowed to include areas with forest cover in the 10 years prior to the project application in their carbon estimation areas (CEAs, or the areas that are credited under the method), contrary to the method's requirements.

- Measurement errors. The suggestion that HIR projects have been allowed to misapply the models that are used to estimate sequestration, resulting in the over-estimation of abatement. This concern relates to the fact that HIR projects have been allowed to include significant amounts of mature woody vegetation when initially stratifying their CEAs, yet the models are calibrated on the assumption CEAs contain little or no woody biomass at the commencement of regeneration.

- Additionality. The suggestion the method is crediting non-additional abatement because it is based on a flawed assumption that grazing control has a significant influence on woody cover across all eligible lands, whereas the evidence suggests rainfall is the primary determinant of carbon stock changes in the uncleared, semi-arid vegetation communities where HIR is typically applied.

In response to the concerns raised about additionality, the Emissions Reduction Assurance Committee (ERAC) commissioned a report from AnalytEcon Pty Ltd (the Beare and Chambers report) that was published in late 2021. The report analysed changes in sparse woody and forest cover in 123 projects (72 in New South Wales (NSW) and 51 in Queensland (QLD)) and concluded:

> Overall, the analysis presented here provides strong evidence that projects established under the HIR method have resulted in significant increases in WF cover [sparse woody and forest cover] in the arid and semi-arid regions of NSW and Queensland.[1]

While Beare and Chambers' words are reassuring, the report suffers a number of methodological flaws. Most notably:

(a) the report defines successful regeneration in terms of a transition from a non-woody state to a sparse woody or forest state ('woody plus forest' or WF) rather than the transition to forest cover – which is the basis for crediting under the method;

(b) the report assesses the impact of the project activities on the basis of trends in woody cover in control areas where sparse woody and forest cover may have been declining – whereas the method credits on the assumption of absolute increases in forest cover from a baseline of zero biomass; and

(c) the report assesses the impact of the project activities using unrepresentative control areas, resulting in the analysis comparing trends in:

  (i) sparse woody and forest cover in CEAs that were specifically selected by proponents on the basis they contained regenerating woody vegetation that had the potential to achieve forest cover; to

  (ii) sparse woody and forest cover in exclusion areas that were specifically selected by proponents on the basis they did not contain regenerating woody vegetation that had the potential to achieve forest cover, or already contained forest cover.

Due to these methodological deficiencies, the results of the Beare and Chambers' analysis are invalid.

However, despite these methodological flaws, the Beare and Chambers' report exposes several significant integrity issues that require further explanation. These include the following.

1. One of the eligibility requirements for land to be included in HIR CEAs is that it must not have had forest cover in the 10 years prior to the project application (the 'baseline period'). Data presented in the Beare and Chambers report suggest that 11-13% of the average hectare of HIR CEAs in NSW and QLD met the crown cover thresholds for forest cover (≥20%) over the so-called 'pre-start' period; the period from 1988 until project commencement. These data raise questions about the extent to which proponents have been allowed to include areas that had forest cover in their baseline periods within their CEAs. The Clean Energy Regulator could resolve this issue by publishing the aggregated forest cover data for HIR CEAs for the baseline periods.

2. The report's headline results suggest that the average difference in sparse woody and forest cover in 2020 that is attributable to the HIR project activities equates to a relative difference of 8% of CEA area in NSW and 4% of CEA area in QLD – when represented on a per hectare basis in satellite-derived woody cover data as 16 25m x 25m pixels, this is equivalent to 1.3 pixels in NSW and 0.6 pixels in QLD. However, the available information suggests that, in the 'average' analysed HIR CEA, the entire area is being credited on the basis it contains roughly 10-year old regeneration, a substantial proportion of which should contain forest cover if the actual onsite biomass reflected the modelled biomass.

[1] Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 1.

3. In addition to the average results, the Beare and Chambers' analysis suggests 23% of all analysed projects, and 37% of the analysed QLD projects, have had no, negative or almost no impact on sparse woody and forest cover relative to what would have otherwise occurred.

4. The HIR method is intended to credit the abatement associated with projects that involve the regeneration of native forests. Due to this, a key measure of the success of HIR projects should be the extent to which they have increased forest cover. Inexplicably, the report does not present data on the change in forest cover in the analysed CEAs over the period since project commencement. All it provides is information on the number of 25m x 25m pixels in the average and median hectare of HIR CEAs in NSW and QLD projects that contained non-woody, sparse woody and forest cover during the so-called 'pre-start' (from 1988 until project commencement) and 'post-start' (from project commencement until 2020) periods. These data suggest the increases in forest cover in the average CEAs between these two periods were relatively small. Forest cover in the average hectare of HIR CEAs increased from 11% to 22% of pixels in NSW and from 13% to 16% of pixels in QLD. Notably, forest cover also increased after projects began in the parts of the project areas that were not included in CEAs (what are commonly known as 'exclusion areas'). In the average hectare of exclusion areas, forest cover increased from 38% to 46% of pixels in NSW and from 41% to 44% of pixels in QLD.

To get further insights into the extent of any forest cover increase, we analysed changes in forest cover in the project areas of all projects in NSW and QLD that were registered prior to 2017 for which there were available data (i.e. replicating the approach taken in the Beare and Chambers report). We identified 73 projects in NSW and 46 in QLD that met this criteria.

Our analysis suggests 48% (35) of the NSW projects and 52% (24) of QLD projects experienced a decline in the amount of forest cover within their project areas over this period, and that the average and median change in forest cover by project was negligible (mean of 186 ha and median of 33 ha across the 119 projects – relative to an average project area 32,449 ha). Despite forest cover barely increasing, almost 17.5 million ACCUs were issued to these projects from project commencement up until the end of the 2019-20 financial year. The 59 projects that experienced a net decrease in forest cover in their project areas received 8.2 million ACCUs, worth around $200 million.

In light of the information presented in the Beare and Chambers' report and the results of our analysis, it is difficult to understand how the method could meet the offsets integrity standards. This is because of the following.

- The method is meant to result in abatement that is 'unlikely to occur in the ordinary course of business (disregarding the effects of this Act)' – yet most of the sequestration that has been credited to the analysed projects is unlikely to have even occurred and, at best, the project activities may be responsible for a small increase in sparse woody and forest cover that would not otherwise have happened.

- All ERF methods are meant to be 'supported by clear and convincing evidence' – yet the existing scientific literature suggests grazing control has relatively limited impact on the biomass of uncleared woody vegetation in rangeland areas and is unlikely to result in areas attaining forest cover that have not previously been deforested. This view is consistent with the evidence on the changes in woody cover associated with the analysed HIR projects.

- The estimates, projections and assumptions in the method are meant to be conservative – yet the method appears to be resulting in the substantial over-crediting of projects.

The HIR method should be immediately revoked and an audit should be undertaken on all registered projects to ensure they are complying with the method's requirements. An independent investigation is also needed to explore the Clean Energy Regulator's administration of the method and the ERF more broadly. Further rule changes may be necessary to prevent the continued crediting of non-additional and non-existent abatement. The failure of the Australian Government to take immediate corrective measures could threatened the reputation and sustainability of the ERF, and undermine the ability of carbon markets to contribute to Australia's greenhouse gas reduction objectives.

1. Introduction

The Emissions Reduction Fund (ERF) is the centre-piece of the Australian Government's climate policy. It was first introduced in 2014 and is comprised of three main elements: a carbon offset crediting scheme, which provides for the issuance of Australian carbon credit units (ACCUs) to projects that abate emissions; a purchasing scheme, whereby the Clean Energy Regulator (on behalf of the Australian Government) voluntarily purchases ACCUs from eligible offset projects; and the 'Safeguard Mechanism', which imposes emission obligations on designated large facilities that can be met through the relinquishment of ACCUs. In simple terms, the purchasing scheme and Safeguard Mechanism are intended to provide the demand for the mitigation supplied by the offset scheme. Demand from the voluntary market, where companies, state and local governments and others seek to offset their emissions for marketing, social licence and altruistic purposes, provides a further source of ACCU demand.

For the ERF to serve its purpose of incentivising abatement that helps Australia to meet its international climate change obligations,[2] the offsets must have environmental integrity. While there is a need to balance integrity and efficiency, to the extent possible, ACCUs should represent 1 tonne of carbon dioxide equivalent (CO_2-e) avoided or sequestered. This principle is embodied in the legislation that underpins the ERF, the *Carbon Credits (Carbon Farming Initiative) Act 2011* (CFI Act), which requires all offset methods to meet six offsets integrity standards, including that the projects covered by the methods should result in abatement that is 'unlikely to occur in the ordinary course of business (disregarding the effects of this Act)', the methods should be 'supported by clear and convincing evidence', and the estimates, projections and assumptions in the methods 'should be conservative'.[3]

At the time of writing, there were more than 1000 registered offset projects, which had received 103 million ACCUs.[4] The Clean Energy Regulator's purchasing scheme had committed $2.6 billion to purchase 209 million ACCUs, of which almost $920 million had been paid for 73 million ACCUs.[5] Demand from the Safeguard Mechanism has been limited: an average of 170,000 ACCUs per year over the four years of the scheme's operation, excluding 'deemed surrenders' from offset projects undertaken by covered facilities.[6] The voluntary market, on the other hand, has proven to be a more vibrant source of demand, rising from 25,000 ACCUs in 2014-15 to 924,000 in 2020-21.[7]

On the supply side, uptake of offset projects has been dominated by vegetation projects; those involving either the natural regeneration or planting of forests or the avoidance of clearing. The most popular of these has been Human-induced Regeneration (HIR). The HIR method has the most uptake of any method under the ERF and it makes up the largest portion of the abatement purchased by the Clean Energy Regulator.[8] As of November 2021, HIR projects accounted for 32% of all registered ERF projects, 27% of all issued Australian carbon credit units (ACCUs) and

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[2] *Carbon Credits (Carbon Farming Initiative) Act 2011*, s 3.
[3] *Carbon Credits (Carbon Farming Initiative) Act 2011*, ss 133(1)(a), (d) and (g).
[4] Clean Energy Regulator (2021), 'Emissions Reduction Fund project register', available at: http://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (1 December 2021).
[5] Clean Energy Regulator (2021), 'Auctions results', available at: http://www.cleanenergyregulator.gov.au/ERF/auctions-results (1 December 2021).
[6] Clean Energy Regulator (2021), 'Safeguard facility reported emissions', available at: http://www.cleanenergyregulator.gov.au/NGER/National%20greenhouse%20and%20energy%20reporting%20data/safeguard-facility-reported-emissions (1 December 2021).
[7] Clean Energy Regulator (2021), 'Voluntary cancellations', available at: http://www.cleanenergyregulator.gov.au/DocumentAssets/Pages/Voluntary-cancellations.aspx (1 December 2021).
[8] *Carbon Credits (Carbon Farming Initiative) (Human-Induced Regeneration of a Permanent Even-Aged Native Forest — 1.1) Methodology Determination 2013*.

more than 50% of all ACCUs contracted through the ERF purchasing scheme, worth approximately $1.5-1.6 billion.[9]

Broadly, the HIR method allows landholders to earn ACCUs for the 'regeneration' of native forests. Forests (and forest cover) are defined for these purposes as an area of at least 0.2 ha with trees that are two metres or more in height and provide crown cover of at least 20 per cent of the land. In order for regeneration to be eligible under the method:

- the land must not have had forest cover in the 10 years prior to the project application;
- during this 10 year period, the land must have been managed in such a way that clearing, livestock or feral grazing, or weeds (the 'suppressors') contributed to the suppression of the development of forest cover; and
- at the date of the project application, 'it is reasonable to expect that it would be necessary to undertake one or more HIR activities on the land in order for it to attain forest cover'.[10]

Projects are credited for the sequestration of CO_2 in eligible regenerating forests (i.e. the live above- and below-ground biomass and debris carbon pools), less emissions associated with fuel use and fire.[11] The amount of CO_2 sequestered in the eligible regenerating forests is not estimated using direct measurements. Proponents are credited on the basis of modelled sequestration. One of two models is used for these purposes: the Australian Government's Full Carbon Accounting Model (FullCAM); or a simplified version of FullCAM called the Reforestation Modelling Tool (RMT), which is only available for use by projects registered prior to March 2016.

Three main integrity concerns have been raised about the HIR method and its administration.

- Crediting of ineligible areas. The suggestion that HIR projects have been allowed to include areas with forest cover in the 10 years prior to the project application in their carbon estimation areas (CEAs, or the areas that are credited under the method), contrary to the method's requirements.
- Measurement errors. The suggestion that HIR projects have been allowed to misapply the models that are used to estimate sequestration, resulting in the over-estimation of abatement. This concern relates to the fact that HIR projects have been allowed to include significant amounts of mature woody vegetation when initially stratifying their CEAs, yet the models are calibrated on the assumption CEAs contain little or no woody biomass at the commencement of regeneration.
- Additionality. The suggestion the method is crediting non-additional abatement because it is based on a flawed assumption that grazing control has a significant influence on woody cover across all eligible lands, whereas the evidence suggests rainfall is the primary determinant in areas that have not previously been cleared.[12]

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[9] Clean Energy Regulator (2021), 'Emissions Reduction Fund project register', available at: http://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (1 December 2021); Clean Energy Regulator (2021), 'Carbon abatement contract register', available at: http://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/carbon-abatement-contract-register (1 December 2021).

[10] *Carbon Credits (Carbon Farming Initiative) (Human-Induced Regeneration of a Permanent Even-Aged Native Forest — 1.1) Methodology Determination 2013*, s 4(c).

[11] The method does not credit changes in soil organic carbon associated for forest regeneration.

[12] Fensham, R., Fairfax, R., Dwyer, J. (2012) Potential aboveground biomass in drought-prone forest used for rangeland pastoralism. *Ecological Applications* 22(3), 894–908; Fensham, R., Laffineur, B., Allen, C. (2018) To what extent is drought- induced tree mortality a natural phenomenon? *Global Ecology and Biogeography* 28, 365–373.

In response to the concerns raised about measurement and additionality, on 5 November 2021, the Emissions Reduction Assurance Committee (ERAC) released a statement that it had 'found that the evidence from robust analysis does not support these concerns'.[13] The primary piece of evidence the ERAC relied on in dismissing the concerns about additionality was a report they had commissioned by Dr Stephen Beare and Professor Raymond Chambers from AnalytEcon Pty Ltd (Beare and Chambers report).[14]

The Beare and Chambers report analysed changes in sparse woody and forest cover in 123 projects (72 in New South Wales (NSW) and 51 in Queensland (QLD)) and concluded:

> Overall, the analysis presented here provides strong evidence that projects established under the HIR method have resulted in significant increases in [sparse woody] cover in the arid and semi-arid regions of NSW and Queensland.[15]

While Beare and Chambers' words are reassuring, the report suffers a number of methodological flaws relating to the way it measured regeneration success and in how it constructed the control areas for the analysis. This paper details these flaws and reviews the report's findings, showing that, even if the methodological deficiencies are ignored, the report and other publicly available information suggest there are significant integrity issues with the HIR method.

The remainder of the paper is set out as follows. Section 2 provides an overview of the objectives and methods used in the Beare and Chambers report and summarises its key findings. Section 3 provides a critique of the method used in the report. Section 4 discusses several integrity issues raised by the report and presents additional analysis on the performance of HIR projects in NSW and QLD. Section 5 provides a conclusion.

2. Overview of the Beare and Chambers report

2.1 Beare and Chambers' method

The Beare and Chambers report contains a complex statistical analysis of the changes in sparse woody (areas with crown cover from woody vegetation of between 5-7% and 19%) and forest cover in the CEAs of 123 projects: 72 in New South Wales (NSW) and 51 in Queensland (QLD). The stated objective of the analysis was:

> … to develop a suitable methodology to assess the effectiveness of the HIR projects. To ensure that the method meets the offsets integrity standard of additionality, its effectiveness is assessed relative to a set of counterfactual predictions. The counterfactual captures the change in woody plus forest (WF) cover that would have been expected, had a project not participated in the HIR method.[16]

To attribute observed changes in sparse woody and forest cover to the project activities, Beare and Chambers constructed a set of 'quasi control' areas for each project. The control areas had two components: an internal control area; and an external control area.

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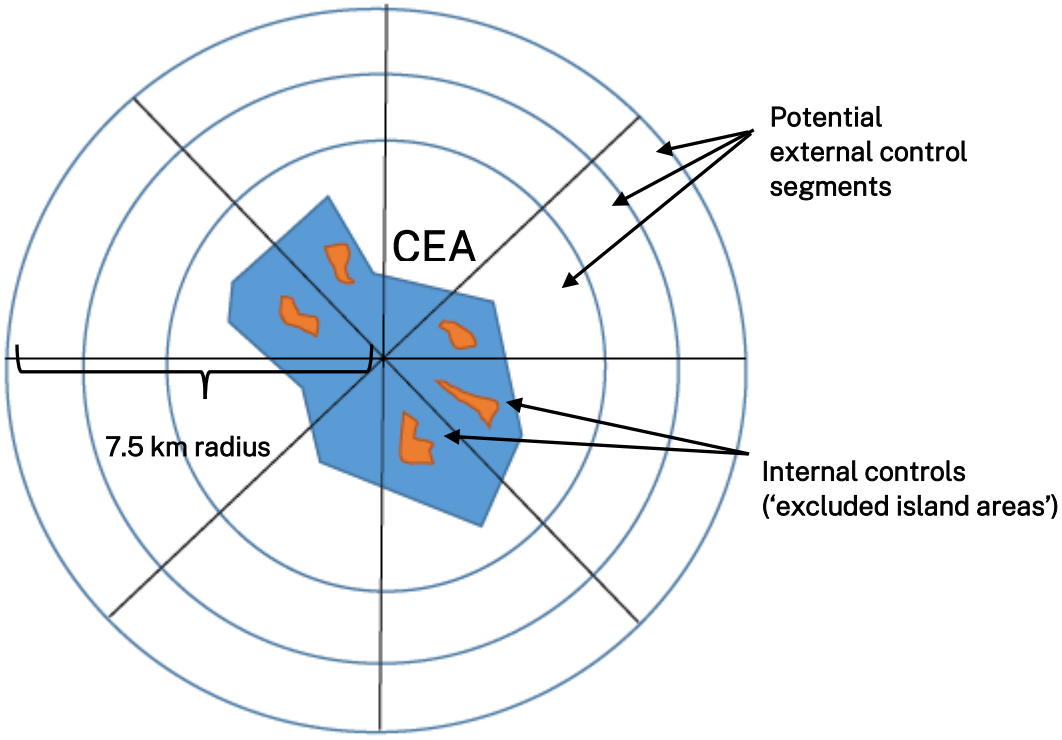
[13] Emissions Reduction Assurance Committee (ERAC) (2021) Statement: ERAC Consideration of Human-induced Regeneration Method. Commonwealth of Australia, Canberra. Available at: http://www.cleanenergyregulator.gov.au/ERF/method-development/emissions-reduction-assurance-committee-publications (1 December 2021).
[14] Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW.
[15] Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 1.
[16] Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 1.

The internal control areas were comprised of areas within the outer CEA boundaries that were excluded from the CEAs by the proponent (what Beare and Chambers refer to as 'excluded island areas' or 'exclusion areas'). In colloquial terms, these areas are 'donut holes' within CEAs that are not credited under the method (see Figure 1).

The external control areas were comprised of areas adjacent to the CEAs. These areas were constructed by identifying a centre point in the project CEAs and drawing three concentric circles around the centre point, with the outer circle having a radius of 7.5 km. Each of the three rings was then divided into eight segments, and each segment was treated as a potential external control area. The area of the CEA and a 100 m buffer around it were excluded from the control segments. Further, if another CEA overlapped a control segment, the segment was eliminated from the study. Figure 1 below illustrates how the control segments were constructed.

After constructing the potential external control segments, Beare and Chambers analysed the historical correlation in 'ground cover' (by which they mean non woody (open), sparse woody and/or forest cover) between the control segments and their CEAs. This was done using the National Forest and Sparse Woody Vegetation Data from 1988 until the year prior to project commencement.[17] If there was an insufficient correlation in the trends in relevant ground cover, the relevant control segment was eliminated from the study and not included in the final external control area.

Figure 1. Construction of HIR potential control segments



[17] Australian Government (2021) *National Forest and Sparse Woody Vegetation Data (Version 5.0 - 2020 Release)*. Available at: https://data.gov.au/data/dataset/national-forest-and-sparse-woody-vegetation-data-version-5-2020-release (1 December 2021). The data for 1988-2020 was presumably used because the sparse woody dataset commences in 1988. The estimates of sparse woody cover that are used in Australia's National Inventory Report for the period 1970-1987 are backcast using the El Niño Southern Oscillation index as a proxy variable. See: Department of Industry, Science, Energy and Resources (2021) *National Inventory Report 2019: The Australian Government Submission to the United Nations Framework Convention on Climate Change, Volume 2*. Commonwealth of Australia, Canberra, p 111.

Having constructed the control areas, Beare and Chambers used:

- the similarity of trends in two of the three cover types (non-woody, sparse woody and forest cover) between the CEAs and their internal controls areas; and
- the similarity of trends in sparse woody and forest cover between the CEAs and their external control areas,

to construct a linear regression model to predict woody cover (sparse woody plus forest cover) in the CEAs over the period from project commencement to 2020 on the basis that the HIR project activities had not been undertaken (called the 'control model', see section 3.1 of Beare and Chambers report). They then used this control model to construct another linear regression model (called the 'attribution model') to predict the impacts of the HIR project activities, as the difference between the observed sparse woody plus forest cover in a given year and that predicted by the control model, based on whether the HIR project had commenced and how many years had passed since commencement (see section 3.2 of Beare and Chambers report). The attribution model is in the form:

$$\Delta Cover_{it} = \beta_1 PostStart_{it} + \beta_2 YearsIn_{it} + \psi_i + \varepsilon_{it}$$

Where:

i = project

t = years

$\Delta Cover_{it}$ = difference in actual observed sparse woody and forest cover and the predicted counterfactual (i.e. if the project had not been undertaken) sparse woody and forest cover for project i in year t, given in 25m x 25m pixels per hectare

$PostStart_{it}$ = indicator variable for project i in year t taking the value 1 on or after program start and 0 before program start

$YearsIn_{it}$ = number of years project i has been in the program

β_1 & β_2 = fixed effects coefficients

Ψ_i= random project effect

ε_{it} = error term, assumed to be uncorrelated noise

As the equation indicates, the primary output of Beare and Chambers' attribution model is an estimate of the difference that the HIR project activities have made to sparse woody and forest cover relative to the counterfactual, expressed in terms of 25m x 25m pixels per hectare. The β_1 and β_2 coefficients for New South Wales and Queensland are provided in Table 1. Hence, for New South Wales, the estimated effect on sparse woody and forest cover in 2020 for a project that commenced in 2016 is given by the parameterised equation:

$$\Delta Cover_{it} = 1*0.447 + 4 * 0.681$$

For Queensland, the equivalent parameterised equation is:

$$\Delta Cover_{it} = 1*0.113 + 4 * 0.055$$

Table 1. Estimation results for the NSW and Queensland attribution models (pixel counts per hectare)

Fixed effects coefficients (β_1, β_2)	Estimate	Standard error	t-value
NSW			
Post-start	0.447	0.036	12.314
Years in	0.681	0.007	9.486
QLD			
Post-start	0.113	0.047	2.4
Years in	0.055	0.011	4.997

Source: Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 25.

For the avoidance of doubt, the outputs of the attribution models are the difference in sparse woody and forest cover relative to the predicted cover from the control model. The models do not provide an estimate of any increase that is attributable to the project activities – in some cases, the absolute change in cover could be negative.

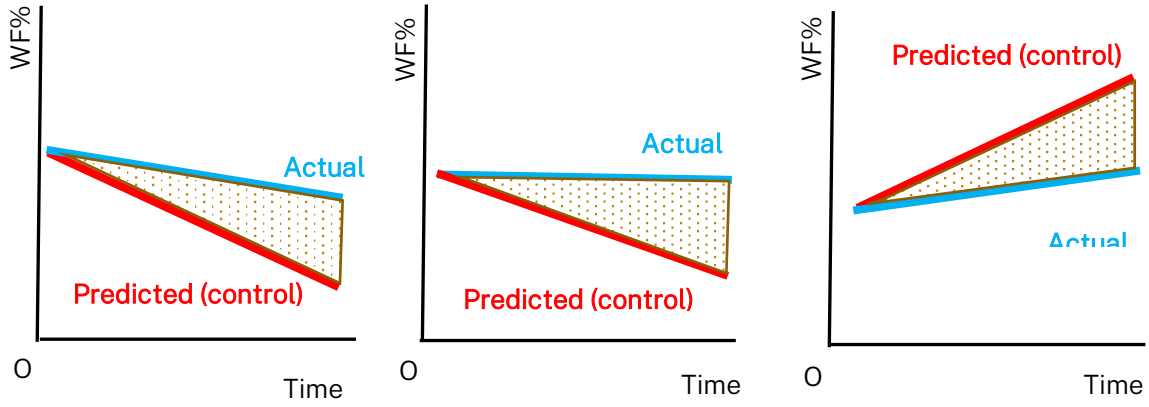
For example, if sparse woody and forest cover in a CEA declined, but the decline in the CEA was less than the decline predicted based in its control model, for these purposes, the project activities would be regarded as having a positive effect on sparse woody and forest cover in the CEA. Equally, if sparse woody and forest cover in a CEA increased, but the increase in the CEA was less than the increase predicted based in its control model, for these purposes, the project activities would be regarded as having a negative effect on sparse woody and forest cover in the CEA. This is illustrated in Figure 2 below, using hypotheticals.

Figure 2. Outputs of models – attributed difference in sparse woody and forest cover (hypothetical examples)

(a) CEA has declining WF% but positive impact relative to control

(b) CEA WF% is unchanged but positive impact relative to control

(c) CEA has increasing WF% but negative impact relative to control



WF% = proportion of sparse woody and forest cover.

Difference in WF%

2.2 Beare and Chambers' results

The headline finding from the Beare and Chambers report was that:

> The results of the analysis suggest that, in 2020, and compared to the average levels of ground cover prior to program entry, the entry of projects in the HIR method accounts for:
>
> - an increase in WF [sparse woody and forest] cover of 17.8 per cent in NSW, with a 95 per cent confidence interval between 16.5 and 19.0 per cent; and
> - an increase in WF [sparse woody and forest] cover of 9.5 per cent in Queensland, with a 95 per cent confidence interval between 7.7 and 11.3 per cent.[18]

Note that the percentage scale used for these headline figures is a percentage of 'average levels of ground cover prior to program entry', not pixels or a percentage of CEA area as used throughout the remainder of the report. Further, the report does not provide any data on the levels of sparse woody and forest cover in CEAs immediately prior to the date on which projects commenced or the level of sparse woody and forest cover in CEAs in 2020. The only data provided on the cover in CEAs relates to undefined 'pre-start' and 'post-start' periods, which appear to be averages from the period 1988 to project commencement (pre-start) and from project commencement to 2020 (post-start). These data are found in Tables 2-2 and 2-3 of the Beare and Chambers report and are reproduced in Table 2 below.

Given the context, Beare and Chambers' reference to the 'average levels of ground cover prior to program entry' in the quote above appears to refer to 'pre-start' cover.[19] On this basis, the report's results suggest that the average difference in sparse woody and forest cover in 2020 that is attributable to the HIR project activities equates to a relative difference of 8% of CEA area in NSW and 4% of CEA area in QLD (or, when represented on a per hectare basis in satellite-derived woody cover data as 16 25m x 25m pixels, the equivalent of 1.3 pixels in NSW and 0.6 pixels in QLD).[20]

[18] Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 3.

[19] This interpretation is supported by Table 3-5 of the Beare and Chambers report, which contains these results. While the text does not provide details on the intended meaning, the title of the Table is 'Estimated program attributions as a percentage of *pre-start average W+F cover*' (emphasis added).

[20] As per Table 2 this report (derived from Table 2-2 of Beare and Chambers report), 'pre-start' sparse woody and forest cover were 46% (35%+11%) for NSW and 41% (28%+13%) for QLD. Converted to 16 pixel equivalents, this equates to 7.3 and 6.5 pixels respectively. The attributed difference relative to pre-start sparse woody and forest cover as at 2020 (as per Table 3-5 of Beare and Chambers) was 17.793% for NSW and 9.497% for QLD. For NSW, 17.793% x 7.3 pixels = 1.3 pixels. For QLD, 9.497% x 6.5 pixels = 0.6 pixels.

Table 2. Summary statistics for NSW and QLD CEAs, average pixel per ha and percentages

	NSW				QLD			
	CEAs	%	Exclusion areas*	%	CEAs	%	Exclusion areas*	%
Pre-start								
Open	6.48	54%	5.63	37%	6.83	59%	5.64	40%
Woody	4.17	35%	3.92	25%	3.2	28%	2.66	19%
Forest	1.26	11%	5.87	38%	1.45	13%	5.82	41%
Total	11.91	100%	15.42	100%	11.48	100%	14.12	100%
Post-start								
Open	4.84	41%	5.31	34%	6.16	54%	5.74	40%
Woody	4.44	37%	3.06	20%	3.43	30%	2.19	15%
Forest	2.59	22%	7.10	46%	1.86	16%	6.32	44%
Total	11.87	100%	15.47	100%	11.45	100%	14.25	100%

* Exclusion areas refer to areas within the project boundaries of an HIR project that are not included within a CEA. Beare and Chambers describe them as 'excluded island areas' and describe than as being 'within the CEAs'. However, they appear to be talking about what are commonly known as exclusion areas.
Source: Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, pp 11-12.

3. Critique of the Beare and Chambers method

There are three main weaknesses with the method Beare and Chambers used to assess the additionality of HIR projects.

(a) The report defines successful regeneration in terms of a transition from a non-woody state to a sparse woody or forest state ('woody plus forest' or WF) rather than the transition to forest cover – which is the basis for crediting under the method.

(b) The report assesses the impact of the project activities on the basis of trends in woody cover in control areas where sparse woody and forest cover may have been declining – whereas the method credits on the assumption of absolute increases in forest cover from a baseline of zero biomass.

(c) The report assesses the impact of the project activities using unrepresentative control areas, resulting in the analysis comparing trends in:

  (i) sparse woody and forest cover in CEAs that were specifically selected by proponents on the basis they contained regenerating woody vegetation that had the potential to achieve forest cover; to

  (ii) sparse woody and forest cover in exclusion areas that were specifically selected by proponents on the basis they did not contain regenerating woody vegetation that had the potential to achieve forest cover.

Each of these three issues are discussed in further detail below.

3.1 Use of transition to sparse woody cover as a measure of 'successful regeneration'

The HIR method is intended to credit the abatement associated with projects that involve the regeneration of native forests. This is plain from the name of the method: *Human-Induced Regeneration of a Permanent Even-Aged Native Forest* (emphasis added). Section 7(1) of the HIR method also makes this clear (emphasis added):

> For paragraph 106(1)(a) of the Act, this determination applies to an offsets project that:
>
> (a) involves:
>
> (i) assisting the regeneration of native forest; and
>
> (ii) the attainment of forest cover;
>
> by undertaking one or more HIR activities on land that does not have forest cover; and
>
> (b) can reasonably be expected to result in eligible carbon abatement.

Despite the method being wholly based on the regeneration of native forests and forest cover, Beare and Chambers define 'successful revegetation … to mean a change from open to either woody or forest cover'.[21]

Using the transition from non-woody (open) to either sparse woody or forest as a measure of successful regeneration is inappropriate for the purposes of assessing the additionality of the abatement credited under the method. This is for three reasons.

First, under the HIR method, all lands included in CEAs are modelled and credited on the basis they contain regenerating native forest (i.e. woody vegetation that, at maturity, has crown cover ≥20%), not regenerating native sparse woody vegetation (i.e. woody vegetation that, at maturity, has crown cover <20%). The difference between the amounts of carbon modelled in regenerating forests compared to regenerating sparse woody vegetation communities is significant – modelled biomass in forests in the areas in NSW and QLD that contain HIR projects after 25 years generally ranges between 6-15 tonnes of carbon (tC) per hectare (ha), while sparse woody communities are modelled as having a maximum biomass of 5 tC per ha, which is reached after 20 years.[22] Hence, what matters most for the purposes of the method is the proportion of the CEAs that has achieved forest cover; not the increase in sparse woody cover. If the object of the method was to credit revegetation of sparse woody communities, it would need to be redesigned and an alternative sequestration model would need to be used.

Second, there is considerable climate-induced variability in sparse woody cover and greater uncertainty about the accuracy of the data concerning sparse woody cover relative to forest cover. Since 2000, gains in areas with sparse woody cover averaged approximately 2 million ha per year, while areas that lost sparse woody cover averaged 1.8 million ha per year.[23] The trends in cover are strongly correlated with fluctuations in the El Niño Southern Oscillation Index.[24] Given these factors, using the transition to sparse woody cover as a measure of the effects of HIR project activities introduces a significant source of uncertainty about the drivers of cover change.

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[21] Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 8.
[22] NIR 2019, Vol 2, p 111.
[23] Department of Industry, Science, Energy and Resources (2021) *Australian Greenhouse Emissions Information System (AGEIS), Data Tables*, available at: https://ageis.climatechange.gov.au/QueryAppendixTable.aspx (1 December 2021).
[24] Department of Industry, Science, Energy and Resources (2021) *National Inventory Report 2019: The Australian Government Submission to the United Nations Framework Convention on Climate Change, Volume 2*. Commonwealth of Australia, Canberra.

Third, the use of transition from non-woody to either sparse woody or forest as a measure of successful regeneration introduces a potential source of bias. At project commencement, CEAs must already have woody vegetation regrowing on the land, which is being kept from achieving forest cover by one of the relevant suppressors. The land in each CEA is also required to have begun regenerating at the same time.[25] Given these requirements, and the fact Beare and Chambers' measured success solely on the basis of the reduction in non-woody cover, the validity of their analysis hinges on the selection of control areas that contain equivalent non-woody areas that also have woody vegetation regrowing on them at the date of project commencement, and for the vegetation to be approximately the same age as the vegetation found in the non-woody areas in the CEAs. As is explored below, the areas with non-woody cover in Beare and Chambers' control areas are unlikely to have had regenerating woody vegetation at project commencement, meaning they are not representative of the conditions in the CEAs.

3.2 Declining cover in control areas

The stated objective of the Beare and Chambers report is 'to assess the effectiveness of the HIR projects'.[26] Any study that seeks to assess the effectiveness of HIR projects must ensure its measures of success align with the objectives of the method. As detailed above, the objective of the HIR method is to support projects that '[assist] the regeneration of native forest' and 'attainment of forest cover'.[27] However, the method used by Beare and Chambers results in a positive difference being attributed to HIR project activities in a CEA if sparse woody and forest cover is declining in the control areas. The only exception to this is where cover in the CEA is also declining and the decline in the CEA is greater than the decline in its control areas.

The method's assumption of zero biomass carbon at model commencement means that success can be defined only in terms of increasing forest cover, not reducing loss of cover relative to the trends in neighbouring areas. By defining success in terms of difference relative to the trends in control areas, and not excluding instances where there were declines in cover in the control areas, the Beare and Chambers report provides a misleading leading picture of successful outcomes.

The flaw in the approach adopted by Beare and Chambers is best illustrated by way of a hypothetical example involving a project where the designated suppressors are livestock and feral grazing and the proponent's project activities involve destocking and increased control of feral grazers. Despite diligently performing the project activities, sparse woody and forest cover do not change. However, the proponent continues to receive ACCUs (at least for 5 years) and uses the revenues from the sale of the ACCUs to finance the clearing of woody vegetation in 'internal' control areas and exclusion areas adjoining the CEAs – this is allowed because they are exclusion areas and are not subject to permanence obligations. The outcome in this case is no change in sparse woody and forest cover in the CEAs, a net reduction in cover more broadly and increased emissions. Yet, according to the method used in the Beare and Chambers, this is a successful outcome, and a positive difference in cover would be attributed to the project's CEAs.

This hypothetical example is not fanciful. There has been increases in clearing in a number of the regions in NSW and QLD with high concentrations of HIR projects, and there is anecdotal evidence to suggest it may be associated with the revenues provided by carbon projects.[28] The

[25] *Carbon Credits (Carbon Farming Initiative) (Human-Induced Regeneration of a Permanent Even-Aged Native Forest — 1.1) Methodology Determination 2013*, s 16(4).
[26] Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 1.
[27] Carbon Credits (Carbon Farming Initiative) (Human-Induced Regeneration of a Permanent Even-Aged Native Forest — 1.1) Methodology Determination 2013, s 7.
[28] For example, see the comments of Peter Yench in the ABC Background Briefing story, 'Boom time in carbon farming country' (21 November 2021). Available at:

hypothesis is that a significant constraint on land clearing in some of these areas is the ability of landholders to access capital to support clearing. Carbon projects are providing landholders with access to a significant revenue stream and some of them may be using it to finance clearing activities in areas outside of CEAs.

Beyond the specifics of this hypothetical, the use of a method that attributes a positive difference to CEAs where cover in the control areas is declining, even when cover in the CEAs is not increasing, is flawed.

3.3 Unrepresentative control areas

As discussed in section 2, the control areas used in the Beare and Chambers report were comprised of two broad parts: internal control areas and external control areas. The internal control areas were exclusion areas within the outer boundaries of the CEAs (the 'excluded island areas' or donut holes). The external control areas were constructed by drawing three concentric circles around the centre point of each CEA (outer circle with a radius of 7.5 km) and divided the three rings into eight segments. The historical correlation in cover between the control segments and their CEAs was then analysed from 1988 until the year prior to project commencement. Segments were excluded if there was insufficient correlation in the trends in cover with the CEA.

While theoretically attractive, Beare and Chambers' method does not account for the reality of the project activities or the eligibility requirements that dictate how CEAs are delineated. Importantly, the HIR method requires CEAs to meet the following requirements.[29]

- They must not include areas that had forest cover at any time in the 10 years prior to the project application being made.
- They must only contain areas that have 'forest potential' – areas of at least 0.2 ha with woody vegetation with the potential to reach 2m in height and more than 20% crown cover.
- They must consist only of land that first exhibited regeneration at or around the same time.
- They must consist only of land across which a similar mix of native vegetation is regenerating.

Further, over the baseline period, clearing, livestock or feral grazing, or weeds must have contributed to the suppression of the development of forest cover, and at the date of the project application, it must have been reasonable to expect the mitigation of the suppressors would be necessary for it to attain forest cover.[30]

The HIR method essentially awards credits on the basis of the area included in CEAs. Consequently, there is a strong financial incentive for proponents to include all areas that have forest potential within CEAs and to include as much area that is close to the forest threshold as possible within CEAs. Moreover, because of the relatively limited use of fencing in the regions in which projects are located, the project mechanism (typically the control of livestock and feral herbivores) tends to affect the whole project area, or most or a significant proportion of it. Beare and Chambers partially acknowledge this in their report where they state:

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https://www.abc.net.au/radionational/programs/backgroundbriefing/boom-time-in-carbon-farming-country/13637436 (1 December 2021).

[29] *Carbon Credits (Carbon Farming Initiative) (Human-Induced Regeneration of a Permanent Even-Aged Native Forest — 1.1) Methodology Determination 2013*, ss 4 and 16.

[30] *Carbon Credits (Carbon Farming Initiative) (Human-Induced Regeneration of a Permanent Even-Aged Native Forest — 1.1) Methodology Determination 2013*, s 4.

> In the excluded areas in NSW there has been an increase in forest cover mostly at the expense of woody cover. This increase is not credited under the HIR method but may indicate that management practices have had a positive effect on reforestation in the excluded areas as well.[31]

Hence, as a project proponent, there is a good land management-related rationale for including as much land as possible in CEAs (i.e. the proponent is incurring the costs of the land management changes so they should be credited for all of the positive impacts). Where areas with non-woody cover within the project boundaries are not included in CEAs, it is reasonable to presume that it is likely to be a product of the fact that they did not contain regenerating woody vegetation that is capable of achieving forest cover. Because of this, and the fact Beare and Chambers measured success on the basis of the transition from non-woody to woody cover, these open areas should not be used as controls.

However, Beare and Chambers included the systematically excluded areas that form islands within the CEAs in their control areas (the internal control areas). They justify this by noting:

> The excluded areas are potentially of interest as they may serve as internal controls under suitable conditions, for instance, if changes in land cover in these excluded areas *are not affected by HIR management practices*.[32] (Emphasis added)

Yet as Beare and Chambers later tacitly acknowledge, because of the relative lack of fencing, the HIR project activities will tend to affect any excluded islands within the CEAs.[33] Further, the trends in cover in these 'internal' exclusion areas have a strong influence on their control models' prediction of counterfactual cover in the CEAs.[34]

The construction of the external control areas using concentric circles around the centroid of the CEAs also means they will commonly include bare or sparse areas excluded from CEAs on the basis they lacked the potential to significantly increase in cover. This is illustrated in the hypothetical diagram below (Figure 3). In the diagram, the thick red box represents the project boundary, the blue areas represent five hypothetical CEAs, the green areas represent exclusion areas and the white areas represent areas outside of the project boundary (as the project boundaries typically follow property boundaries the white areas will usually be adjoining properties). Where the centroid of a CEA does not lie within 7.5 km of the project boundary, all of the relevant control segments will be comprised of exclusion areas (e.g. CEA 2). In most other cases, a substantial or significant proportion of the control segments will be made up of exclusion areas (e.g. CEAs 1, 3, 4 and 5) – the only exception is where CEAs are in close proximity to the project boundaries on several sides.

As noted, the open (or non-woody) areas in the exclusion areas (whether they are inside or outside the CEA boundaries) are unlikely to contain regenerating woody vegetation that is capable of achieving forest cover, which is a defining characteristic of the open areas found within CEAs. The open areas are also unlikely to contain regenerating woody vegetation that is of the same age as that found in the CEAs. Due to these issues, the controls are invalid, rendering the analysis invalid.

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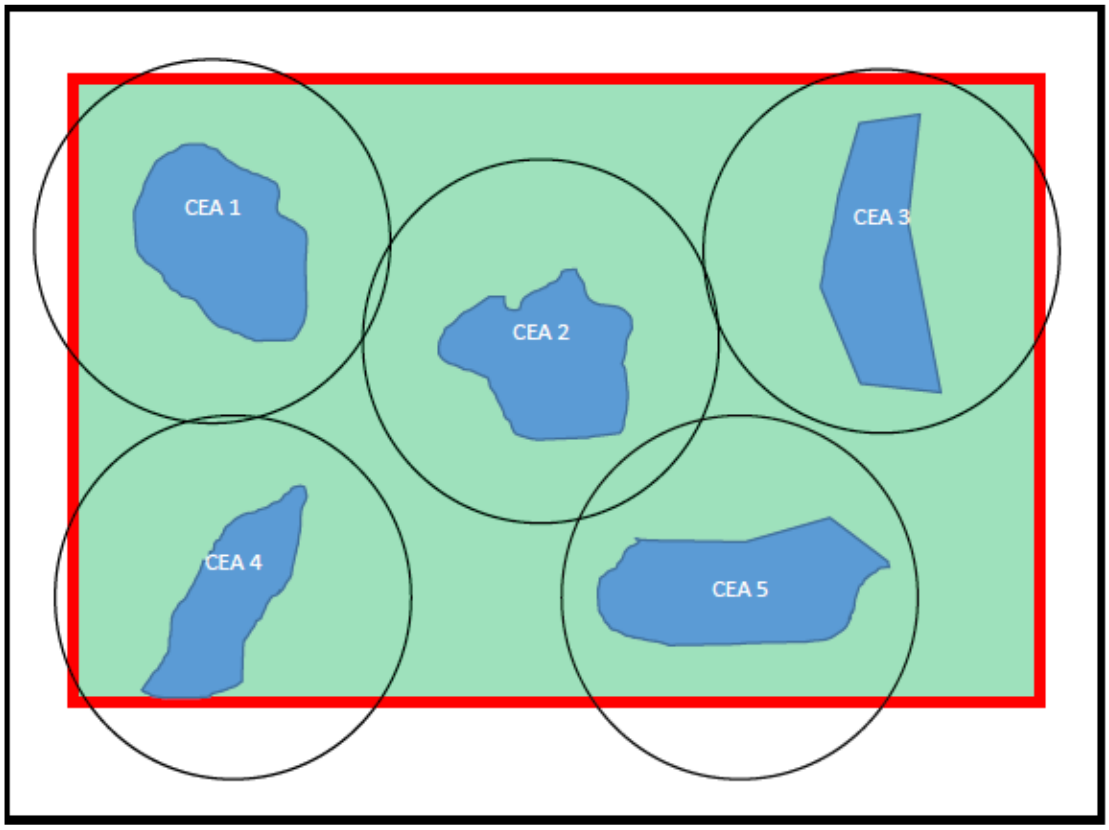
[31] Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 11.
[32] Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 9.
[33] Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 11.
[34] Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 21-22 (Tables 3-1 and 3-2), noting the t-values for the relevant woody cover counts for both the NSW and Qld models are highly significant.

Figure 3. Application of external control area selection method to hypothetical project area and CEAs. Red box represents the project boundary, blue areas represent CEAs, green areas represent exclusion areas (non-CEA areas) within the project boundary, and white areas represent areas outside of the project boundary.



4. Integrity issues raised by the report

Despite the methodological flaws in the Beare and Chambers report, the data contained in the report expose several significant integrity issues associated with the HIR method and its administration that require further explanation.

4.1 Ineligible forest areas not excluded from CEAs

As noted in the Introduction, one of the eligibility requirements for land included in HIR CEAs is that it must not have had forest cover in the 10 years prior to the project application (the 'baseline period'). Data presented in Tables 2-2 and 2-3 in the Beare and Chambers report (reproduced in Table 2 above) suggest that 11-13% of the average hectare of HIR CEAs in NSW and QLD met the crown cover thresholds for forest cover (≥20%) over the so-called 'pre-start' period (the period from 1988 until project commencement). In the text of their report, Beare and Chambers state:

> Within the CEAs there is a large proportion of open land cover, but all have some (usually very small) areas of forest cover prior to the start of each project. As the CEA is required to exclude forest cover, this may be the results of measurement errors, either in the FullCAM database or in the geocoding of the CEAs.[35]

[35] Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 11.

Beare and Chambers' explanation for the presence of forest cover is unconvincing. The 2019 ERAC review found that a significant proportion of CEAs had forest cover in their baseline periods. As the ERAC report notes:

> … the Department's analysis of National Accounts tiles SG55 and SH55 found forest cover in the CEAs of a sample of HIR and NFMR projects was approximately 14–15 per cent in 2013 when the methods first commenced and 5–7 per cent in 2010.[36]

In late 2018, early 2019, changes were made to the *Carbon Credits (Carbon Farming Initiative) Act Rule 2015*, and the Clean Energy Regulator issued new guidance,[37] requiring proponents to identify and remove areas of land from CEAs that had forest cover during their baseline periods. This process should have resulted in the removal of most areas that are detected as having forest in their baseline periods, according to the National Forest and Sparse Woody dataset. The fact 11-13% of the average analysed hectare of HIR CEAs met the crown cover thresholds for forest cover during the pre-start period raises questions about the extent to which this has occurred.

The Clean Energy Regulator could resolve this issue by publishing the aggregated forest cover data for HIR CEAs for the baseline periods. The Clean Energy Regulator has these data and could release them without contravening its secrecy obligations under the CFI Act.

4.2 Over-crediting of HIR projects

The report's results and associated data suggest the analysed projects are being substantially over-credited. The available data suggest the majority (possibly all) of the project CEAs that were analysed have modelling commencement dates (the date when regeneration commenced in the CEA) that pre-date the project commencement date. A significant proportion of the modelling commencement dates are likely to fall over the period 2009-2011, which coincides with the rains associated with the 2010–11 and 2011–12 La Niña events.[38] This is detailed in the ERAC review of the HIR method in 2019, which states:

> Most HIR projects have modelled 7–9 years of regeneration to date because they have typically nominated the point of regeneration as occurring in 2009–11, a period of high rainfall.[39]

This means that, in most or a substantial proportion of cases, the CEAs are likely to have been credited on the basis they contain approximately 10-12-year old forest regeneration (roughly

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[36] Emissions Reduction Assurance Committee (2019) *Review of the Human-Induced Regeneration and Native Forest from Managed Regrowth methods*. Commonwealth of Australia, Canberra, p 39.

[37] Clean Energy Regulator (2019) *Guidelines on stratification, evidence and records: For projects under the Human-Induced Regeneration of a Permanent Even-Aged Native Forest and Native Forest from Managed Regrowth methods*. Commonwealth of Australia, Canberra. Available at: http://cleanenergyregulator.gov.au/DocumentAssets/Documents/Guidelines%20on%20stratification%20evidence%20and%20records%20for%20HIR%20and%20NFMR.pdf (1 December 2021).

[38] The Beare and Chambers report states that: 'The average project age in NSW, from start date through 2020, is 8.1 years. The corresponding average project age in Queensland is 5. 8 years' (p 10). The report also states that 'the difference in average ages for the two States is 2.3 years' (p 26), whereas the data on the ERF Project Register suggest there is only a 4 month difference in the average age of the projects (based on their date of registration). See Clean Energy Regulator (2021), 'Emissions Reduction Fund project register', available at: http://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (1 December 2021). It is possible Beare and Chambers used the modelling commencement dates rather than project registration dates in their analysis and that they were not aware of the differences in these concepts. Due to the ambiguity and resulting uncertainty, we have relied on the 2019 ERAC report as the more reliable source of information on modelling commencement dates. The ERAC and the Clean Energy Regulator should release further information on modelling commencement dates to assist in the analysis of the extent to which HIR projects are underperforming.

[39] Emissions Reduction Assurance Committee (2019) *Review of the Human-Induced Regeneration and Native Forest from Managed Regrowth methods*. Commonwealth of Australia, Canberra, p 31.

3.0-7.5 tC per ha, based on the representative plots contained in Figure 2.1 of the ERAC 2019 report). Reflecting this, to date, the projects included in the study have received more than 22.5 million ACCUs.[40]

Analysis conducted for the 2019 ERAC review found that forest cover in the areas in NSW and QLD where projects are located should be attained by the time carbon in the trees (above and below ground) and the associated debris pool reaches approximately 3.6–5.5 tonnes per hectare.[41] The 2016 version of FullCAM that many projects are using suggests this level of carbon sequestration is typically reached after 10–14 years of regeneration. Consequently, given the modelled levels of forest growth, the data should show a substantial increase in the proportion of the CEAs with forest cover (not just sparse woody cover).

Inexplicably, the report does not present data on CEA forest cover in 2020 or in the year prior to project commencement. As discussed, all it provides is information on the number of 25m x 25m pixels in the average and median hectare of HIR CEAs in NSW and QLD projects that contained non-woody, sparse woody and forest cover during the so-called 'pre-start' (from 1988 until project commencement) and 'post-start' (from project commencement until 2020) periods. These data suggest the increases in forest cover in the average CEAs between these two periods were relatively small. Forest cover in the average hectare of HIR CEAs increased from 11% to 22% of pixels in NSW and from 13% to 16% of pixels in QLD (see Table 2 above). This equates to an average increase in forest cover of only 1.8 pixels in NSW and 0.6 pixels in QLD, out of 16 per ha.

Notably, forest cover also increased after projects began in the parts of the project areas that were not included in CEAs (the 'exclusion areas'). In the average hectare of exclusion areas, forest cover increased from 38% to 46% of pixels in NSW and from 41% to 44% of pixels in QLD.

4.3 A new analysis of forest cover in NSW and QLD project areas

To obtain further insights into the extent of any forest cover increase associated with the projects, we analysed changes in forest cover in the project areas of all projects in NSW and QLD that were registered prior to 2017 for which there were available data (i.e. replicating the approach taken in the Beare and Chambers report). We identified 73 projects in NSW and 46 in QLD that met this criteria.[42] We then analysed the change in 25m x 25m pixels in the project areas with forest cover between the year prior to project registration and 2020 using the National Forest and Sparse Woody Vegetation Dataset.[43]

The analysis suggests 48% of the NSW projects (35 of 73) and 52% of QLD projects (24 of 46) experienced a decline in the amount of forest cover within their project areas over this period, and that the average and median change in forest cover by project was negligible (mean of 186

[40] Clean Energy Regulator (2021), 'Emissions Reduction Fund project register', available at: http://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (1 December 2021).
[41] Larmour, J., Davies, M., Paul, K., England, J., Roxburgh, S. (2018) *Relating canopy cover and average height to the biomass of the stand. Report prepared for the Department of the Environment and Energy*. CSIRO Land and Water, Canberra.
[42] Explanation is requires as to how Beare and Chambers identified 51 projects in QLD – there are only 46 projects in QLD that have registration dates prior to 2017.
[43] Australian Government (2021) *National Forest and Sparse Woody Vegetation Data (Version 5.0 - 2020 Release)*. Available at: https://data.gov.au/data/dataset/national-forest-and-sparse-woody-vegetation-data-version-5-2020-release (1 December 2021). The data for 1988-2020 was presumably used because the sparse woody dataset commences in 1988. The estimates of sparse woody cover that are used in Australia's National Inventory Report for the period 1970-1987 are backcast using the El Niño Southern Oscillation index as a proxy variable. See: Department of Industry, Science, Energy and Resources (2021) *National Inventory Report 2019: The Australian Government Submission to the United Nations Framework Convention on Climate Change, Volume 2*. Commonwealth of Australia, Canberra, p 111.

ha and median of 33 ha across the 119 projects – relative to an average project area 32,449 ha) (Table 3).

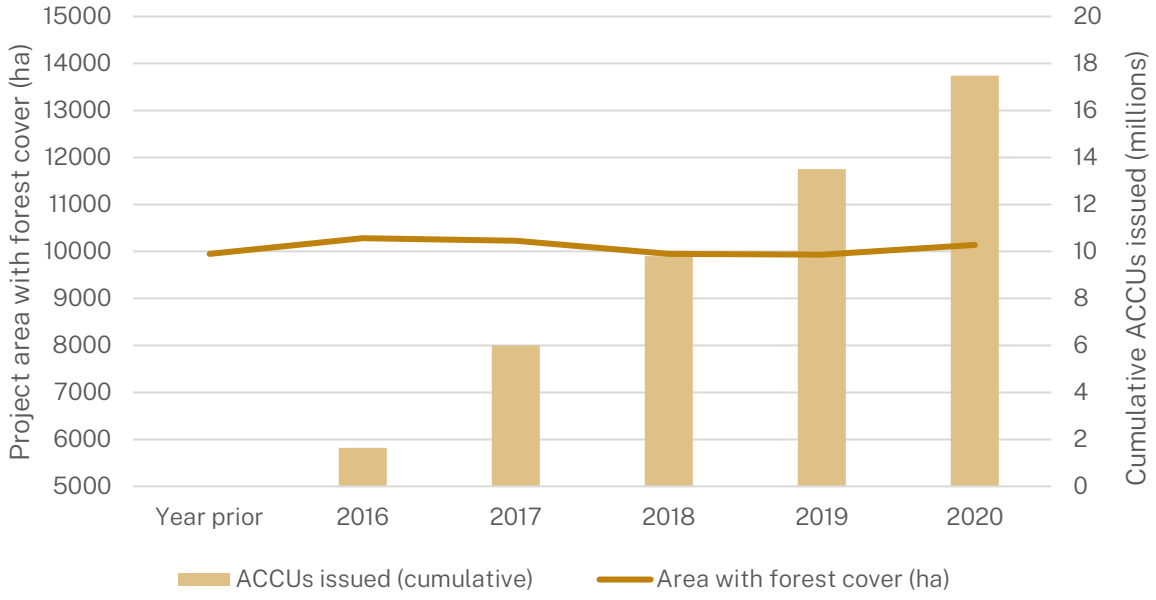
Table 3. Change in forest cover in project areas of NSW and QLD projects, from project commencement to 2020, hectares and ACCUs received

	No. projects	Total project area (ha)	Change in forest area (ha) - mean	Change in forest area (ha) - median	Projects with negative forest cover change (no.)	Total ACCUs	ACCUs received by projects with negative forest cover change
NSW	73	1,972,352	-62	52	35	10,669,815	4,903,263
QLD	46	1,889,134	580	-94	24	6,815,964	3,312,829
Total	119	3,861,485	186	33	59	17,485,779	8,216,092

Source: Clean Energy Regulator (2021), 'Emissions Reduction Fund project register', available at: http://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (1 December 2021); Australian Government (2021) National Forest and Sparse Woody Vegetation Data (Version 5.0 - 2020 Release). Available at: https://data.gov.au/data/dataset/national-forest-and-sparse-woody-vegetation-data-version-5-2020-release (1 December 2021); and author analysis.

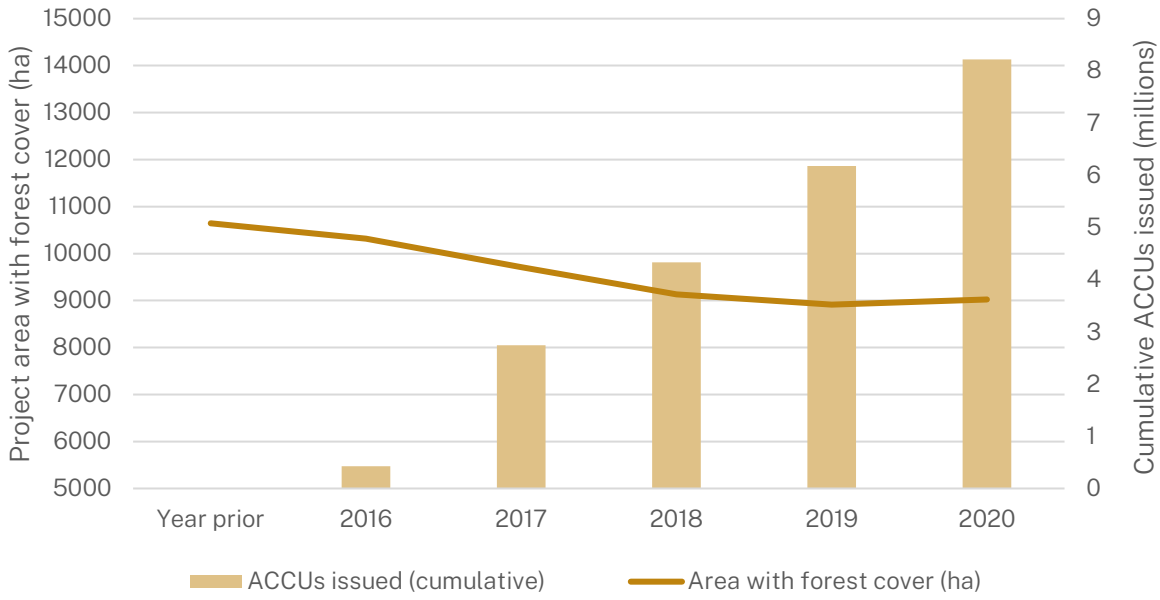
Despite forest cover barely increasing, almost 17.5 million ACCUs were issued to these projects from project commencement up until the end of the 2019-20 financial year (Figure 4). The 59 projects that experienced a net decrease in forest cover in their project areas received 8.2 million ACCUs, worth around $200 million (Figure 5). While this analysis is confined to the project areas – not the CEAs (the CEA data are not publicly available) – it suggests there are significant issues that require further explanation regarding the performance of the projects and the assumptions that underpin the method.

Figure 4. Analysed NSW and QLD projects, average area with forest cover in project areas (in hectares) and cumulative ACCUs issued, year prior to project commencement to 2020



Source: Clean Energy Regulator (2021), 'Emissions Reduction Fund project register', available at: http://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (1 December 2021); Australian Government (2021) National Forest and Sparse Woody Vegetation Data (Version 5.0 - 2020 Release). Available at: https://data.gov.au/data/dataset/national-forest-and-sparse-woody-vegetation-data-version-5-2020-release (1 December 2021); and author analysis.

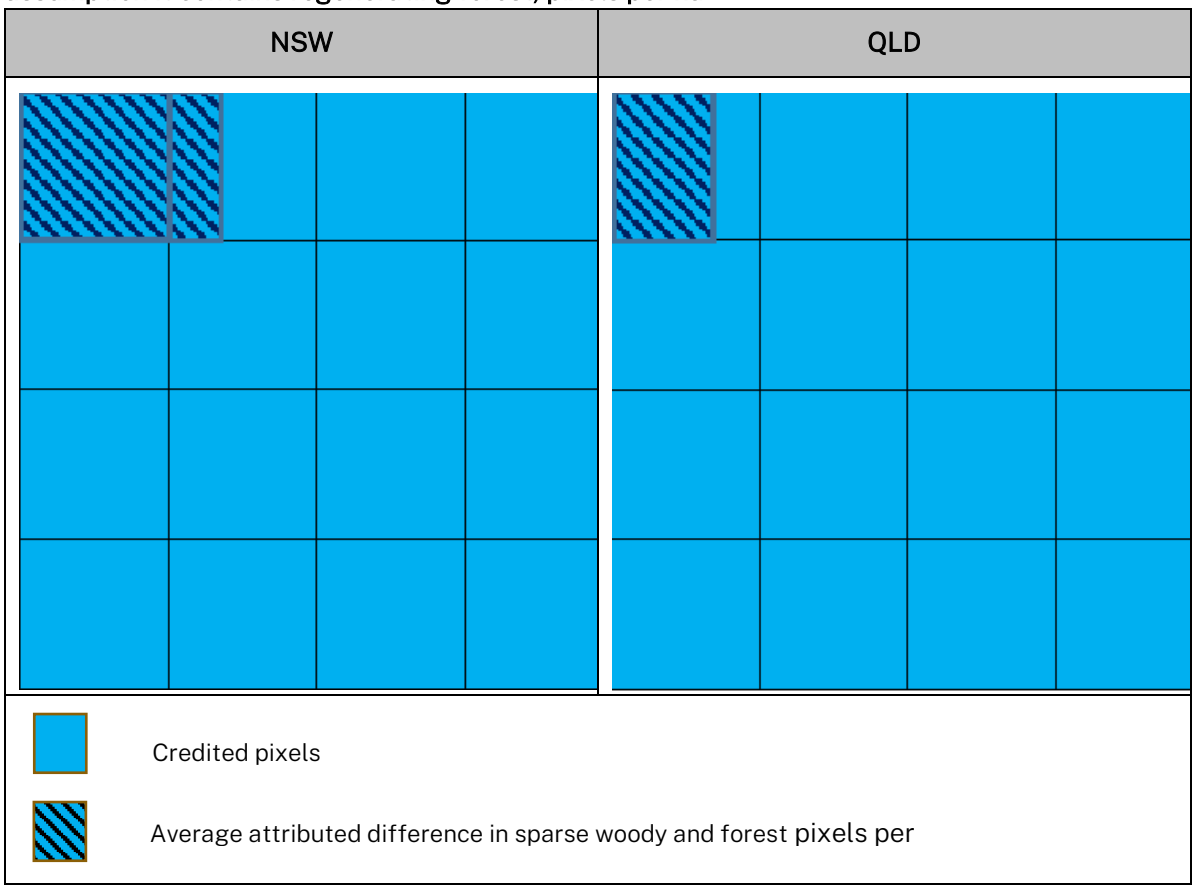
Figure 5. Analysed NSW and QLD projects with net decline in forest cover, average area with forest cover in project areas (in hectares) and cumulative ACCUs issued, year prior to project commencement to 2020



Source: Clean Energy Regulator (2021), 'Emissions Reduction Fund project register', available at: http://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (1 December 2021); Australian Government (2021) National Forest and Sparse Woody Vegetation Data (Version 5.0 - 2020 Release). Available at: https://data.gov.au/data/dataset/national-forest-and-sparse-woody-vegetation-data-version-5-2020-release (1 December 2021); and author analysis.

The results of the analysis conducted by Beare and Chambers raise similar issues about the underperformance of the projects relative to the amount of credits they have received. As noted in section 2 above, Beare and Chambers found that the average difference in sparse woody and forest cover in 2020 that is attributable to the HIR project activities equates to a relative difference of 8% of CEA area in NSW and 4% of CEA area in QLD (or, when represented on a per hectare basis in satellite-derived woody cover data as 16 25m x 25m pixels, the equivalent of 1.3 pixels in NSW and 0.6 pixels in QLD – see Table 2 and footnote 20). All 16 pixels per ha are likely credited on the basis they contain roughly 10-year old regenerating forest – yet, on average, the attributed difference is a mere 0.6-1.3 pixels out of 16 per ha of sparse woody and forest cover. These average results are illustrated in Figure 6.

Figure 6. Average attributed difference in sparse woody and forest cover vs area credited on assumption it contains regenerating forest, pixels per ha



Further evidence that the analysed projects are, as a whole, underperforming and being over-credited is found in section 4.1 the Beare and Chambers' report, which contains data on the distribution of the outputs from their attribution model expressed as a percentage of the pre-start sparse woody and forest cover for each project (see Beare and Chambers report, Figure 4-1, reproduced below in table format). As shown in Table 4, according to their analysis, 13% of projects in NSW and 37% of projects in QLD had no, negative or almost no impact on sparse woody and forest cover relative to the counterfactual. For these purposes, we regard an attributed increase relative to the counterfactual of less than 4.45% in NSW and 4.75% in QLD on pre-start sparse woody and forest cover as 'near zero', given the full 100% is likely being credited as containing roughly 10-year old regenerating forest (Figure 4). These results suggest that almost 25% of the projects in the sample had no, negative or almost no impact on sparse woody and forest cover.

Beare and Chambers' comment in their report that their 'analysis provides strong evidence that the HIR method has resulted in significant increases in WF cover in the arid and semi-arid regions of NSW and Queensland'.[44] This statement relates only to the statistical tests of significance. It does not equate to material increases in comparison to the way projects are being credited – something that the Beare and Chambers report does not analyse. The evidence from their report and our analysis demonstrates the projects are likely being substantially over-credited and raises questions about their long-term capacity to attain and retain forest cover.

[44] Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 3.

Table 4. Attributed difference in sparse woody and forest cover, as percentage of pre-start cover, by project*

NSW								
Bin No.	1	2	3	4	5	6	7	8
Bin interval	8.90%	8.90%	8.90%	8.90%	8.90%	8.90%	8.90%	8.90%
Bin minimum	-13.34%	-4.45%	4.45%	13.34%	22.24%	31.14%	40.03%	48.93%
Bin maximum	-4.45%	4.45%	13.34%	22.24%	31.14%	40.03%	48.93%	57.83%
Mid interval	-8.90%	0.00%	8.90%	17.79%	26.69%	35.59%	44.48%	53.38%
No. projects	2	7	18	18	12	11	3	1
Cumulative %	3%	13%	38%	63%	79%	94%	99%	100%
QLD								
Bin No.	1	2	3	4	5	6	7	8
Bin interval	9.50%	9.50%	9.50%	9.50%	9.50%	9.50%	9.50%	9.50%
Bin minimum	-33.24%	-23.74%	-14.25%	-4.75%	4.75%	14.25%	23.74%	33.24%
Bin maximum	-23.74%	-14.25%	-4.75%	4.75%	14.25%	23.74%	33.24%	42.74%
Mid interval	-28.49%	-18.99%	-9.50%	0.00%	9.50%	18.99%	28.49%	37.99%
No. projects	1	1	8	9	16	6	6	4
Cumulative %	2%	4%	20%	37%	69%	80%	92%	100%

Source: Beare, S., Chambers, R. (2021) *Human induced regeneration: A spatiotemporal study*. AnalytEcon Pty Ltd, Berry, NSW, p 32.

* As shown, we assumed the bin intervals were constant. However, in the histograms presented in the report, the bins to the right of the means appear to have smaller bin intervals than those around the centre of the distribution. This does not affect the conclusions discussed above.

5. Conclusion

The ERAC has claimed the Beare and Chambers report suggests there is no basis for the concerns raised about the integrity of the HIR method. However, the report suffers a number of methodological flaws that render the analysis invalid. Most notably:

(a) the report defines successful regeneration in terms of a transition from a non-woody state to a sparse woody or forest state ('woody plus forest' or WF) rather than the transition to forest cover – which is the basis for crediting under the method;

(b) the report assesses the impact of the project activities on the basis of trends in woody cover in control areas where sparse woody and forest cover may have been declining – whereas the method credits on the assumption of absolute increases in forest cover from a baseline of zero biomass; and

(c) the report assesses the impact of the project activities using unrepresentative control areas, resulting in the analysis comparing trends in:

  (i) sparse woody and forest cover in CEAs that were specifically selected by proponents on the basis they contained regenerating woody vegetation that had the potential to achieve forest cover; to

  (ii) sparse woody and forest cover in exclusion areas that were specifically selected by proponents on the basis they did not contain regenerating woody vegetation that had the potential to achieve forest cover, or already contained forest cover.

Further, even if these methodological flaws are ignored, the Beare and Chambers' report exposes several significant integrity issues that require further explanation. These include the following.

1. One of the eligibility requirements for land to be included in HIR CEAs is that it must not have had forest cover in the 10 years prior to the project application (the 'baseline period'). Data presented in the Beare and Chambers report suggest that 11-13% of the average hectare of HIR CEAs in NSW and QLD met the crown cover thresholds for forest cover (≥20%) over the so-called 'pre-start' period; the period from 1988 until project commencement. These data raise questions about the extent to which proponents have been allowed to include areas that had forest cover in their baseline periods within their CEAs. The Clean Energy Regulator could resolve this issue by publishing the aggregated forest cover data for HIR CEAs for the baseline periods.

2. The report's headline results suggest that the average difference in sparse woody and forest cover in 2020 that is attributable to the HIR project activities equates to a relative difference of 8% of CEA area in NSW and 4% of CEA area in QLD – when represented on a per hectare basis in satellite-derived woody cover data as 16 25m x 25m pixels, this is equivalent to 1.3 pixels in NSW and 0.6 pixels in QLD. However, the available information suggests that, in the 'average' analysed HIR CEA, the entire area is being credited on the basis it contains roughly 10-year old regeneration, a substantial proportion of which should contain forest cover if the actual onsite biomass reflected the modelled biomass.

3. In addition to the average results, the Beare and Chambers' analysis suggests 23% of all analysed projects, and 37% of the analysed QLD projects, have had no, negative or almost no impact on sparse woody and forest cover relative to what would have otherwise occurred.

4. The HIR method is intended to credit the abatement associated with projects that involve the regeneration of native forests. Due to this, a key measure of the success of HIR projects should be the extent to which they have increased forest cover. Inexplicably, the report does not present data on the change in forest cover in the analysed CEAs over the period since project commencement. All it provides is information on the number of 25m x 25m pixels in the average and median hectare of HIR CEAs in NSW and QLD projects that contained non-woody, sparse woody and forest cover during the so-called 'pre-start' (from 1988 until project commencement) and 'post-start' (from project commencement until 2020) periods. These data suggest the increases in forest cover in the average CEAs between these two periods were relatively small. Forest cover in the average hectare of HIR CEAs increased from 11% to 22% of pixels in NSW and from 13% to 16% of pixels in QLD. Notably, forest cover also increased after projects began in the parts of the project areas that were not included in CEAs (what are commonly known as 'exclusion areas'). In the average hectare of exclusion areas, forest cover increased from 38% to 46% of pixels in NSW and from 41% to 44% of pixels in QLD.

To get further insights into the extent of any forest cover increase, we analysed changes in forest cover in the project areas of all projects in NSW and QLD that were registered prior to 2017 for which there were available data (i.e. replicating the approach taken in the Beare and Chambers report). We identified 73 projects in NSW and 46 in QLD that met this criteria.

Our analysis suggests 48% (35) of the NSW projects and 52% (24) of QLD projects experienced a decline in the amount of forest cover within their project areas over this period, and that the average and median change in forest cover by project was negligible (mean of 186 ha and median of 33 ha across the 119 projects – relative to an average project area 32,449 ha). Despite

forest cover barely increasing, almost 17.5 million ACCUs were issued to these projects from project commencement up until the end of the 2019-20 financial year. The 59 projects that experienced a net decrease in forest cover in their project areas received 8.2 million ACCUs, worth around $200 million.

In light of the information presented in the Beare and Chambers' report and the results of our analysis, it is difficult to understand how the method could meet the offsets integrity standards. This is because of the following.

- The method is meant to result in abatement that is 'unlikely to occur in the ordinary course of business (disregarding the effects of this Act)' – yet most of the sequestration that has been credited to the analysed projects is unlikely to have even occurred and, at best, the project activities may be responsible for a small increase in sparse woody and forest cover that would not otherwise have happened.

- All ERF methods are meant to be 'supported by clear and convincing evidence' – yet the existing scientific literature suggests grazing control has relatively limited impact on the biomass of uncleared woody vegetation in rangeland areas and is unlikely to result in areas attaining forest cover that have not previously been deforested. This view is consistent with the evidence on the changes in woody cover associated with the analysed HIR projects.

- The estimates, projections and assumptions in the method are meant to be conservative – yet the method appears to be resulting in the substantial over-crediting of projects.

The HIR method should be immediately revoked and an audit should be undertaken on all registered projects to ensure they are complying with the method's requirements. An independent investigation is also needed to explore the Clean Energy Regulator's administration of the method and the ERF more broadly. Further rule changes may be necessary to prevent the continued crediting of non-additional and non-existent abatement. The failure of the Australian Government to take immediate corrective measures could threatened the reputation and sustainability of the ERF, and undermine the ability of carbon markets to contribute to Australia's greenhouse gas reduction objectives.