H2ONESTLY

SUBMISSION TO INDEPENDENT REVIEW OF ACCU:
RESOLVING ERF INTEGRITY ISSUES THROUGH CAUSAL SCIENCE

26 September 2022

1. SCOPE & STRUCTURE OF THIS SUBMISSION

We present two headline claims to the Panel's scoped tasks:

i) **The integrity of the ERF methods is fundamentally flawed by its poor scientific basis.**

ii) **Classical falsification science operationalised by Causal AI can now permanently fix these integrity issues. The new tech offers a seismic improvement in what the ERF can achieve in carbon abatement and co-benefit intervention outcomes.**

The impact of the current scientific failings is profound and widespread. Although we focus in this submission on methodological aspects, the governance of the ERF is clearly also compromised by the lack of scientific integrity in the way that carbon abatement claims are assessed and verified. Adopting a defensible scientific basis would also greatly improve the governance and overall performance of the ERF, but we defer discussion of governance aspects to comply with the Panel's request that each submission should be limited to four pages. We will consequently concentrate here on the methodological questions posed by the Panel, and have moved some detailed supporting evidence for our claims to appendices.

H2onestly offers specialist independent advice to agencies and industry on solving complex environmental challenges using the best available decision-support tools. As part of our service we have critically reviewed current "best practice" analysis methods founded on correlations, probability and statistics, including neural networks, machine learning, stochastic analysis and systems dynamics models. At the ACCU Review Panel's invitation, we have more specifically examined the ERF's methodologies and FullCAM's operationalisation and published approaches.

This submission sets out justifications for our headline claims, and makes the case that Causal AI provides an ideal and ready means of transforming the ERF into a flexible, transparent and trustworthy system for evaluating claims of carbon abatement and co-benefit credits. H2onestly is not expert in Causal Science and has no IP that we are selling. We have examined current capabilities in depth however, and are aware of at least one company in Australia who have the technology required to apply the robust scientific paradigms to the ERF recommended below. We encourage you to challenge our claims, and would be more than happy to meet with the Panel and present our arguments in more detail.

2. AXIOMS OF SCIENCE

For any carbon or co-benefit accreditation scheme to be fully defensible, claims of achievement must be validated by a rigorous scientific process of inquiry and inference. In essence this requires:

1. **Claims are not evaluated on the basis of authority, assumptions or beliefs, but rather by testing falsifiable and transparently articulated causal hypotheses against evidence.**
2. **Any hypothesis which is inconsistent with all credible evidence must be discarded in favour of a hypothesis which is consistent with all evidence.**
3. **Scientific integrity can only be achieved when claims are justified on the basis of hypotheses that have not been falsified by evidence.**

The Review Panel is tasked with finding ways to improve the capacity and integrity of the ERF for achieving carbon abatement targets. We suggest that the most efficient means of achieving ACCU integrity efficiently is to apply the scientific method systematically to understand what causes carbon abatement, and to design interventions on the basis of this knowledge. The current Offsets Integrity Standards are bureaucratic (Attachment A) and current ERF claim evaluations are not scientifically defensible. This is unsurprising given the current state of analytical "best practice" which exclusively use correlational methods to examine historical datasets. With the advent of Causal AI, best practice has switched up a gear and now permits the application of rigorous science in the ERF method design and verification processes.

The above axioms of science are neither new nor original, they have been distilled from hundreds of years of scientific learning and endeavour (Popper, 1959). What is new is that breakthrough methods (Pearl, 2009) are now available for inferring and quantifying causal relationships which harness these axioms. When powered by AI tools it is now possible to analyse and understand systems through their causal laws, such as the laws of thermodynamics. This approach is fundamentally different and orders of magnitude more powerful than current correlational methods.

3. HOW CURRENT METHODS FAIL IN SCIENTIFIC INTEGRITY

Our first major claim is that current abatement methods hide and ignore a great deal of bias and uncertainty by permitting the frequent application of hypotheses which have been or can readily be falsified. The methods thus lack scientific integrity and transparency, and are consequently subject to frequent and justified criticism which undermines the ERF's integrity. Suggestions that widespread fraud by over-compensation is occurring cannot be reliably denied without basing claim evaluations on scientific integrity (see definitions in Attachment A).

To justify our first headline claim, we have set out in Attachment B a small number of examples (from a large range of candidates) from the current debate between ERAC and Professor Macintosh and his ANU colleagues which illustrate deviations from the scientific axioms set out above. In doing so we are not seeking merely to identify the specific failures of the arguments presented, but rather to highlight that unscientific reasoning is endemic throughout the ERF methodologies.

For example, ERAC supports and defends (Clean Energy Regulator, 2022) the HIR methodology (Australian Government, 2013). FullCAM computes how much woody thickening, and therefore biomass increase, will occur using algorithms which interpret a wide range of divergent, inconsistent and often highly contested beliefs about the causes and limitations of tree growth following clearing. As noted by Macintosh et al (2022), the hypotheses about what causes molecular carbon to be transferred from atmosphere to biomass due to the approved interventions (e.g. fencing and feral animal control), and whether it will stay there as long as 25 years through droughts and fires, is far from settled. The competing hypotheses on what causes and affects this type of tree growth are selectively discussed in some of the supporting literature (Roxburgh et al., 2019; Paul & Roxburgh, 2020), yet FullCAM makes its predictions using algorithms implying that a single hypothesis about biomass change is true, adjusted using further questionable relationships about responses to predicted rainfall and a few other factors.

ERAC's defence of the HIR (Beare and Chambers, 2021) does not seek to separate and account for any other causal hypotheses, but rather concentrates on a spatio-statistical historical analysis of forest cover in approved HIR projects. One of the most glaring problems with this study is its calculation of the counterfactual, i.e. the amount of woody thickening which would have occurred if the HIR-approved actions had not occurred.

Beare and Chambers (2022) employ a convoluted statistical model which uses satellite imagery of forest cover in surrounding lands to determine the counterfactual. Their method ignores, for example, the causal factors on which the Carbon Estimation Areas (CEAs) were selected – e.g. CEAs were chosen due to their relatively low productivity, fencing efficiency, existing forest cover and a range of other factors which renders them unique and different to the surrounding non-selected areas. These key causal factors are not specifically accounted for in the described counterfactual calculation.

A final example of poor science presented in Attachment B is Macintosh et al's (2022) repeated claims that the coincident drought and forest cover trends demonstrate that rainfall is the (only) significant factor in increased biomass since 2010-2012. On more detailed analysis these authors would likely agree that rainfall is not the only causal factor which explains change in the tree growth rates (such as pests and foragers), yet their conclusion that it is just rainfall is presented as being a simple and incontrovertible "truth by authority".

Our point in all these cases is that there is no systematic analysis of all valid hypotheses against relevant evidence being conducted. Instead, a single hypothesis is championed with cherry-picked evidence to advance a specific argument. This kind of science is fatally flawed by confirmation bias and other logical shortcomings, and greatly limits the validity of the respective conclusions.

The implications of this poor science are profound. In contravention of the legislative requirements for methodological integrity for example, there is currently no scientifically valid confirmation that the approved accreditation is conservative or otherwise. Farmers who really are reducing atmospheric carbon may be short-changed whilst others doing less (or indeed nothing) may be inappropriately rewarded. Regenerative measures which cause real water and biodiversity co-benefits are not being suitably encouraged. Investors, farmers and government commitments are at high risk of financial failure due to a legitimate lack of trust in the carbon market.

4. CAUSAL AI – AN OPTIMAL BASIS FOR CARBON AND CO-BENEFIT ACCREDITATION

Our second major claim is that the ideal means of rendering the ERF not only compliant with Kyoto and Paris abatement obligations but embodying defensible, future-proof and world leading integrity is to evaluate carbon abatement and co-benefit claims through Causal AI. Fundamentally, this requires that all claims are evaluated using predictions of causal relationships which are not falsified by credible evidence, and that the knowledge gained from monitoring and verifying claims is used to systematically learn and improve the ERF's intelligence systems.

The evaluation and systematic learning process which can now be readily developed through Causal AI is summarised in Attachment C. In essence the workflow involves simultaneously evaluating all hypotheses about what causes what to happen against evidence about the system of interest. Hypotheses which are not falsified by the evidence are then ranked against the evidence and those which fit best are selected for iterative analysis and further refinement against diagnostic evidence until an acceptable and transparent level of certainty is achieved about what is causing what to happen. The causal relationships quantified by this process are then used to predict both the outcomes of proposed interventions and to calculate their counterfactuals, enabling all benefits and impacts to be accurately quantified and transparently compared to find the most efficient means to achieve a chosen goal, such as verifying the validity of an ACCU claim.

5. ADVANTAGES OF TRANSITIONING TO ACCU'S WITH SCIENTIFIC INTEGRITY

Causal AI offers much more than improved scientific integrity to the ERF. It also offers the proven ability to design optimal strategies for achieving desired outcomes, taking account of the full spectrum of impacts and benefits which will arise from each proposed intervention or methodology. The advantages to transitioning the ERF from current unsound methods to a high-integrity system based on Causal AI include:

- The ERF would provide optimally efficient and transparent offsetting that meets Kyoto and Paris Agreement obligations, and that can be readily adjusted to meet any other domestic or international target that the government agrees.
- Land owners, regulators, consultants and other stakeholders will be able to personally confirm that the offset credits are legitimate, additional and as permanent as the ERF objective requires using the best available knowledge. As the integrity of ACCU's will be rendered the most reliable and robust in the world, they will likely become the benchmark for international full-spectrum offset claim evaluations.

- Whilst it will be necessary to progressively update the offset allocations as better understanding of the causal drivers of climate abatement and co-benefits arise through systematic verification of abatement dynamics, an equitable basis for doing this without major fluctuations in price or market capacity will be available.
- Australia's productivity and reputation will be greatly improved, particularly in relation to climate change efforts (where we are seen as global laggards) and AI-led innovation.
- All positive and negative impacts of the scheme will be quantifiably predictable, allowing trade-offs in carbon abatement, biodiversity co-benefits and socio-economic impacts to be optimised in accordance with the government's and stakeholder's selected axiology (suite of values), all accessible on one integrated platform.

6. CONCLUSIONS & RECOMMENDATIONS

6.1 Conclusions

In answer to the methodology questions posed by the Panel, we conclude:

- The Offsets Integrity Standards and current ACCU determination system are not sufficiently rigorous, and should be replaced by a paradigm which embraces the scientific method, i.e. transparent hypothesis testing against evidence to quantitatively determine causal laws.
- By moving to a scientifically defensible basis for determinations using Causal AI, many or all of the current ACCU integrity issues will be permanently overcome. This shift would further enable ERF managers to design and justify equitable biodiversity credits, reward other co-benefits valued by stakeholders and to optimally avoid or mitigate perverse outcomes in one integrated system.

Causal AI is poised to become the international standard for evaluating abatement claims due to its inarguably higher scientific integrity and flexibility to incorporate co-benefits. By leading the breakthrough, ERF managers can progressively phase out current low-integrity ACCU's that would otherwise lose most of their value in the near future at great cost to the Australian government and the ERF. By doing so, the Panel will also place Australia's in the forefront of global efforts to reach its targets to reach "Net Zero" as efficiently and productively as practicable, as well as enhancing Australia's reputation as an AI-savvy innovation nation.

6.2 Recommendations

A scientific learning, decision support and strategy-making framework enabled by Causal AI should ultimately be applied to all parts of the ERF accreditation scheme. Our recommended starting point is to apply causal science to develop a high-integrity, transparent and continuously learning framework for estimating counterfactuals. Once the capacity of Causal AI is demonstrated in this capacity, it can be expanded to develop an integrated framework for evaluating and designing interventions which maximise carbon sequestration, biodiversity improvements and any other chosen co-benefit desired by regulators and stakeholders.

We further recommend that the basis for the above claims should be approached through a causal science education program, one in which a truly scientific basis for decision making and counterfactual calculation is investigated, challenged and understood by regulators and practitioners. Once the current capacity of Causal AI to operationalise a rigorous scientific framework for progressively improving the accounting of carbon sequestration and ecosystem benefit causes and effects is confirmed, we predict that regulators, farmers and taxpayers will insist on its new level of integrity, convenience and transparency.

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Attachment A: Definitions of Key Terms

Causal Science:

Our use of the term Causal Science (or causal inference) follows Popper's (1959) epistemology of robust science, which champions a rigorous process of articulating and testing hypotheses and discarding any that are falsified by evidence. Judea Pearl (2009) greatly advanced this scientific framework with a new mathematical formalism called the "do calculus", enabled by formalised graphical analysis of system causes and effects linked through Bayes Theorem. The legitimacy and importance of Pearl's work has now been accepted by the world's great scientific institutions (BBVA Foundation, 2022).

Noting these antecedents, we define causal science as a formal learning paradigm applying Causal Inference to test and potentially falsify quantitative hypotheses about what causes what to happen.

Integrity:

Although "integrity" is not defined specifically in relevant legislation or agency websites, some clarity on how the Australian Government uses the term in relation to carbon credits is provided in Section 133 of the Carbon Credits (Carbon Farming Initiative) Act 2011 (CFI Act); partly reproduced as follows:

(1) For the purposes of this Act, the ***offsets integrity standards*** are as follows:
(a) …
(b) to the extent to which a method specified in, or ascertained in accordance with, a methodology determination in accordance with paragraph 106(1)(c) involves ascertaining any of the following:
(i) the removal of one or more greenhouse gases from the atmosphere;
(ii) the reduction of emissions of one or more greenhouse gases into the atmosphere;
(iii) the emission of one or more greenhouse gases into the atmosphere;
the removal, reduction or emission, as the case may be, should be:
(iv) measurable; and
(v) capable of being verified;
…
(g) to the extent to which a method specified in, or ascertained in accordance with, a methodology determination in accordance with paragraph 106(1)(c) involves an estimate, projection or assumption--the estimate, projection or assumption should be conservative.

Macintosh et al. (2022) imply a similarly imprecise but slightly less bureaucratic meaning for integrity:

> *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 (CO2-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'.*

The widespread use of a paralegal definition of "integrity" in the carbon abatement literature is exemplified in ERAC's document setting out their interpretation of these legislated "integrity standards". In essence, integrity is achieved by following the methods - no opportunity to challenge or update the methods is provided.

We define **integrity** in a much more concrete sense, as being **scientifically justifiable using a model which is not falsified by any credible evidence**. Only by applying a scientifically, rather than a politically or economically, rigorous definition of integrity can we move to a truly objective and transparent basis for estimating how much carbon reduction would occur in other circumstances.

Our recommended benchmark to gain integrity in the ERF carbon abatement scheme is to apply the axioms of defensible science; **are the claims substantiated by a transparent hypothesis which is not falsified by credible evidence? Are there other hypotheses which also remain possible? If so, which one(s) best fit the evidence?**

Evidence: Not in a legal but a scientific sense. **Evidence must be empirical**, i.e. reducible to data/observation dimensions. Legal arguments or document references are not evidence in this sense. Opinions, estimates and beliefs are hypotheses, not evidence.

Counterfactual: We define a counterfactual as what would have resulted without a specific intervention having occurred. The difference between the two is the effect of the intervention (cause). In ERF terms, the counterfactual on which an ACCU should be certified is the difference between the atmospheric carbon reductions that occur following a method-approved action and the amount of carbon that would have been expected, had a project not participated in the ERF program.

The counterfactual does not exist and for this reason we can't measure it, we can only estimate it relative to an alternative condition which does exist (the fact to which it counters). Counterfactual conditions should be defined in terms of an explicit causal model (this happened because of this action), or set of scientifically plausible models. Using a scientific paradigm with Causal AI, the estimation of counterfactuals becomes a routine calculation which can be questioned by anyone and on which ACCU payments can be scientifically justified.

Additionality: The GHG emission reductions claimed by the mitigation activity shall be additional, i.e., they would not have occurred in the absence of the incentive created by carbon credit interventions (Integrity Council, 2022).

Method: As interpreted by the regulators (DISER & CER), a legislative instrument that sets the rules for calculating ACCU's due to specific actions. They advise that the "method must be consistent with the legislation and approved by the Emissions Reduction Advisory Committee (ERAC)" If a methodology is followed and compliance is deemed by CER to have been achieved, it becomes eligible to be issued ACCUs without further verification. This is a purely bureaucratic interpretation of the term.

We would define and design methods differently if using a causal epistemology; the following definition is preferred:

> **A method is a means of analysing data to discover something which we didn't know. A method explains how a thing will be discovered, clearly and mathematically**.

Attachment B: Examples of current claim evaluation using falsified hypotheses

There are many examples of poor science being used by HIR promoters and critics in the contradictory integrity claims now being examined by the Chubb Review Panel.

As stated above, our assertion of "poor science" lies in the use of invalid, readily falsified or inappropriately restricted hypotheses in arguing the competing claims. We note that many of the arguments presented by Macintosh and others also relate to the manner by which ERAC, CER and DISER are administering the compliance regime. We also suggest that the use of epistemologically correct counterfactuals supported by ex post auditing and structured learning from such efforts would greatly improve the integrity of the compliance regime, but we are not exploring governance aspects in this discussion to keep our submission succinct.

The following discussion highlights a number of readily falsified hypotheses used by each of the combatant groups regarding the Human Induced Regeneration of a Permanent Even Aged Native Forest (HIR) Method, but there are many more exemplars which could have been selected.

Falsified claims by ERAC and CER

Two of the key conjectures underlying the HIR methodology is that the volume of carbon sequestered by woody thickening and that the counterfactuals estimated for Carbon Estimation Areas (CEAs) can be reliably and conservatively estimated using statistical techniques. These conjectures are based on a belief that the set of causal factors which control woody growth in stocked and fenced-off areas are adequately known or can be adequately determined using statistical comparisons, despite the numerous confounders and confirmation bias which affect both estimations.

The first example of a readily falsifiable claim in ERAC's arguments is their endorsement of a "mixed effects additive control model" to estimate the HIR counterfactuals in the Beare & Chambers (2021) analysis. Section 3.1 of that report explains their spatio-statistical model which endeavours to account for both fixed and random effects in the natural change of woody biomass on plots of land surrounding the Carbon Estimation Areas (CEAs). The central issue with this conjecture is that the CEA's are chosen by farmers for financial and other reasons (e.g. marginal land that cannot be profitably grazed but which is not already forest-covered). Distribution of forest cover in CEAs will be strongly biased by selection criteria, but this important confounder is not accounted for in the counterfactual estimation.

In essence, the ERF method designers are applying the logic of an experiment to determine counterfactuals, yet there is insufficient capacity to control the many confounding factors which affect the growth of biomass in different land parcels. The use of statistical work-arounds to estimate method counterfactuals remains one of the greatest sources of non-conservative error and uncertainty in the calculation and verification of ACCU's.

To measure the counterfactual (non-intervention) state of a carbon project site by examining the carbon captured in non-selected sites or trends elsewhere exemplifies a basic error of experimental methodology, and may bias the results in favour of (non-conservative) overestimation of long term and additional carbon sequestration.

For each project site, there will be a complex set of contributing causes which affect the biomass volumes in the CEA and surrounding lands are not explicitly accounted for other than by normalising statistical approaches (Paul and Roxburgh, 2020). Specific confounding factors at a project site might include; rainfall, soil moisture, microbial and rhizomic conditions, topography, presence of burrowing animals, soil mineralogy and texture, regional atmospheric CO_2 concentrations, and many others.

Whilst attempts are made, using falsifiable relationships deduced from soil-tube experiments and observations in very different conditions within the FullCAM algorithms, there is little doubt that most or all of these inferred relationships would be invalid and/or only inconsistently true in specific CEA's; nevertheless ACCU's are being credited by following the method.

Equally, the statistical smoothing and curve-fitting methods by which Beare and Chambers (2021) have sought to compare the HIR-credited areas with surrounding lands that were not subject to HIR actions (i.e. clearing and stock grazing) do not specifically account for the various factors which affect biomass accumulation but rather seek to reduce their errors in through statistical workarounds. A strong confirmation bias of the hypotheses that biomass has increased in response to HIR-approved actions, and a reluctance to identify whether other hypotheses such as rainfall-induced biomass change, prevails throughout ERAC's defence.

Another example of a readily falsifiable claim used to calculate and justify HIR ACCU's is the relationship between "woody thickening" and grazing patterns. As pointed out by Macintosh et al (Macintosh, Butler, Evans, et al. 2022b), the causal relationship between these phenomena have been debated for decades by many authors with a range of hypotheses. The algorithms used by FullCAM that assert the scientific truth from these conflicting studies are flimsy at best, and are not supported by any rigorous application of the scientific axioms set out in the introduction of this submission. In particular, there is no real treatment in the FullCAM or methodology documentation of alternate hypotheses about what might also promote or hinder biomass growth, nor of how other causal factors are to be accounted for.

Falsifiable claims by Macintosh et al

In a series of papers published by ANU, Macintosh and his colleagues make a range of claims about the legitimacy and additionality of projects which are currently being credited under the HIR method (Macintosh et al, 2022a; Macintosh et al, 2022b; Macintosh et al, 2022c; Macintosh et al, 2022d).

Two of these papers make the claim that the volume of carbon sequestered in the CEA's selected for audit in their review study (Beare and Chambers 2021) is really due to increased rainfall since 2010-2012, rather than HIR-approved actions. The basis for this interpretation is not adequately justified using the scientific axioms above, i.e. a single hypothesis is held to be true on the basis of coincident timing between increased biomass and increased rainfall, but no other hypotheses which might also fit the evidence appear to be considered in the documents submitted. Although we have not found specific evidence that contravenes the hypothesis due to limited access to the datasets used in the Macintosh et al papers, we would be surprised if the authors would not acknowledge that rainfall is not the only factor that controls biomass growth. If a causal science framework was followed, ALL causal factors would be quantitatively accounted for.

Attachment C: Causal AI workflow applied to the ERF

Scientific justification of causal claims is essential to the integrity of complex-product markets.

The current faults in scientific integrity discussed in Attachment B are common throughout current carbon accounting and many other fields that the Panel will be familiar with, but they are neither optimal nor any longer necessary. A new method for investigating causal relationships directly, rather than indirectly through statistics and correlations in historic data, has been developed by the eminent AI mathematician Judea Pearl. The transformative power of his revolutionary mathematical formalisms for applying causal inference through the "do calculus" and graphical logic approaches has been recognised by many of the great scientific institutions (Horvitz 2012; BBVA Foundation 2022).

Pearl's breakthrough provides a new opportunity to understand systems through causal relationships, which can be identified by investigating each system of interest through a rigorous Popperian hypothesis falsification process, scaled by modern AI tools. Causal laws, like the laws of thermodynamics, are invariant throughout time and space, like gravity and thermodynamics. With the benefit of Causal AI, the causal laws which underpin, and enable quantified prediction of, the sequestration of carbon in any plot of land in any given situation can now be calculated with much greater scientific rigour and confidence than the methods currently employed in the ERF program.

We suggest that the following process for evaluating claims made about carbon sequestration using the HIR or any other method, including the proposed "Integrated Farm Method" and the current proposals for a biodiversity offsets certification program to augment the ERF, will provide much greater integrity, transparency and consistency than current methods allow.

These recommended steps are an adaptation of the "Five Rings" epistemological methodology (copyright Epistemology, 2020), used under licence by H2onestly and reproduced here with permission. Whilst the causal inference steps are robust and manageable using graphical analysis and elementary algebra, it is when they are performed at AI scale using programs such as Epistemology's SKAI software that they can quantitatively analyse any complex system of interest:

1. Identify the values which we rate most highly, and therefore the ones for which we will optimise. In the case of HIR methods, these might for example preference achieving a conservative estimate of the additional carbon which will be captured through prevention of stock and feral animal grazing, followed by valuing practicability and convenience of how this sequestration will be verified.
2. Identify a range of potential hypotheses about what causes carbon sequestration to happen in the circumstances relevant to the proposed method (e.g. what factors affect the growth of woody trees in fenced paddocks and unfenced areas for the HIR method). Convert each of these hypotheses to a quantitative algorithm and use these to predict about what would happen if the hypothesis was true.
3. Compare these predictions to all credible evidence. If the evidence is inconsistent with what is predicted by the hypothesis, the hypothesis is either discarded or amended if a more elaborate version remains consistent with the evidence.
4. Rank all non-falsified hypotheses using their fit to evidence. If there are numerous unfalsified hypotheses which fit the evidence well, collect diagnostic evidence that will falsify one or more of the front-runners, until sufficient confidence is gained that the remaining hypotheses can reliably be used to predict counterfactuals and other key aspects of the system.

5. The top-ranked non-falsified hypothesis is used to predict the volume of carbon which will be sequestered under the circumstances relevant to the CEA, and ACCU's are provisionally credited on this basis.
6. Diagnostic (not general) monitoring data will be collected to verify the predictions of carbon abatement. If new evidence is subsequently found which falsifies the top hypothesis, the ACCU accreditation system will be adjusted accordingly. Any falsely accredited ACCU's will be progressively "grandfathered" in accordance with rules set by CER and DISER.
7. Diagnostic data of the highest information value (Gibson et al. 2017; Bal et al. 2018) will be prioritised and strategically funded based on causal outcome risk. The most relevant knowledge will be sought and iterated as needed to meet the knowledge requirements and acceptable outcome risks. This knowledge will be transparent, in that the full ranking of unfalsified hypotheses can be explained algorithmically to any stakeholder.
8. The new knowledge will be systematically ingested to make predictions and update the ERF predictions and market strategies about carbon abatement program performance.