



OIA Ref: 2021-054

Privacy

2 November 2021

Official information request related to geoengineering

Tēnā koe Privacy

I am writing in response to your email of 4 October 2021 in which you requested the following information under the Official Information Act (OIA):

"Please provide any and all written documents, reports, memos, letters, notes, emails and draft documents in relation to Geoengineering / Weather Modification research, development, activities, proposals, operations, science and governance; including any and all information which is known to the Climate Change Commission, the "Chairperson", "Chief Executive" and "The Minister" but which has not yet been recorded in writing or otherwise regarding the established actually existing suite of Geoengineering / Weather Modification technologies known as Solar Radiation Management, Stratospheric Aerosol Injection, Cloud Seeding, Chemical Ice Nucleation, Ocean Sulphur Cycle Enhancement, Carbon Dioxide Removal, Controlled Perturbation etc. and information on any national or international mechanisms involved in the research, development, activities, operation, deployment and governance of these technologies."

The table below lists the documents within scope of your request. Information within these documents that is out of scope has not been released. Some information has also been withheld under the following sections of the OIA:

- section 9(2)(a) – to protect the privacy of natural persons; and
- section 9(2)(g)(i) – which allows information to be withheld when doing so is necessary to maintain the effective conduct of public affairs through the free and frank expression of opinions by or between or to Ministers of the Crown or members of an organisation or officers and employees of any public service agency or organisation in the course of their duty.

Please note, any knowledge the Commission staff members, Chairperson or Chief Executive hold on geoengineering, beyond that contained in the documents mentioned below is held outside their professional capacity and therefore not within scope of this request.

#	Type	Date	Title	Notes
1.	Board Paper	18 Dec 2019	Background reading on Climate Science fundamentals and the	Some information has been withheld under section 9(2)(a) of the OIA.

			current state of knowledge	
1a.	- Attachment		Summary for Policy Makers	I am refusing this part of your request under section 18(d) of the OIA, as the report is publicly available at: WG1AR5 SPM FINAL.pdf (ipcc.ch) . Please note, geoengineering is only mentioned in passing on page 39 of this report.
2.	Working Doc	21 July 2020	Carbon Capture and Storage- HIP team working document	I am withholding this document in full under section 9(2)(g)(i) of the OIA. Please note, I am withholding this information as it represents early thinking of a free and frank nature, which, if released, could have a chilling effect on future free and frank conversations, thereby negatively impacting the conduct of public affairs. In this case, I consider the need to maintain the effective conduct of public affairs outweighs any public interest in releasing this information.
3.	Emails	20-26 Aug 2020	Email trail on non-forestry removal Board Presentation	Some information has been withheld under sections 9(2)(a) and 9(2)(g)(i) of the OIA. Note: I am withholding the slide pack hyperlinked in the emails of 20 and 24 August (200820-non-forestry removals hypothesis for board v 2.pptx) in full under section 9(2)(g)(i) of the OIA. Note: I am releasing the final version of this document to you. See document 4b below.
3a.	- Attachment		A thought starter on emissions removals (Attached as 200825-non-forestry removals hypothesis for board v5.pptx)	Withheld in full under section 9(2)(g)(i) of the OIA. Note: I am releasing the final version of this document to you. See document 4b below.
3b.	- Attachment		Board paper on non-forestry removals	Withheld in full under section 9(2)(g)(i) of the OIA. Note: I am releasing the final version of this document to you. See document 4b below.
3c.	- Attachment		Royal Society Greenhouse Gas Removal Report 2018	Withheld in full under section 18(d), as it is publicly available at: https://royalsociety.org/-/media/policy/projects/greenhouse-gas-removal/royal-society-greenhouse-gas-removal-report-2018.pdf .
4.	Email	27 Aug 2020	Board presentation and cover paper on non-forestry removals incorporating feedback	
4a.	- Attachment		Board paper on non-forestry removals	Some information has been withheld under section 9(2)(a) of the OIA.

				Note: the additional reading attachment referred to in paragraph 8 of this document is the same as document 3b above.
4b.	- Attachment		A thought starter on emissions removals (Attached as 200825-non-forestry removals hypothesis for board v6.pptx)	
4c.	- Attachment		Royal Society Greenhouse Gas Removal Report 2018	Same as document 3c above.
5.	Notes	9 Sept 2020	Notes on Board discussion of non-forestry removals	I am withholding this document in full under section 9(2)(g)(i) of the OIA. Please note, I am withholding this information as it represents early thinking of a free and frank nature, which, if released, could have a chilling effect on future free and frank conversations, thereby negatively impacting the conduct of public affairs. In this case, I consider the need to maintain the effective conduct of public affairs outweighs any public interest in releasing this information.
6.	Email	10 Sept 2020	Fwd: Climate mitigation research	Please note, the Commission considered blue carbon to be out of scope of your request when sourcing documents it held. However, we have included this email and its attachments, as it came from an external source, and we thought it might be of interest to you.
6a.	- Attachment		Towards an Emissions Reduction Fund... (Attached to email as Australian government-blue-carbon-2019.pdf)	Refused in full under section 18(d), as it is publicly available at: Towards an Emissions Reduction Fund Method for Blue Carbon (industry.gov.au) .
6b.	- Attachment		Technical review of opportunities for including blue carbon... (Attached to email as Kelleway et al 2017.pdf)	Refused in full under section 18(d), as it is publicly available at: Microsoft Word - Coastal carbon emissions technical report - Final.docx (csiro.au) .
7.	Email	20 Sept	Fwd: Climate mitigation research	Some information has been withheld under section 9(2)(a) of the OIA.
7a.	- Attachment		Towards an Emissions Reduction Fund...	Same as document 6a above.
7b.	- Attachment		Technical review of opportunities...	Same as document 6b above.
8.	Board Paper	23-24 Nov 2020	Draft recommendation 24 on CCS in Board papers for 23-24	I am withholding this document in full under section 9(2)(g)(i) of the OIA.

			November 2020 Board Meeting	Please note: the rest of the Board paper has not been released as it is out of scope.
9.	Email	1 Dec 2020	I am sharing '2354.full' with you	Some information has been withheld under section 9(2)(a) of the OIA.
9a.	- Attachment		Social tipping dynamics... (Attached to email as 2354.full.pdf)	Refused in full under section 18(d), as it is publicly available at: Social tipping dynamics for stabilizing Earth's climate by 2050 PNAS .
10.	Email	8 April 2021	08/04/2021 – Full media report	
11.	Published Evidence	Undated	Commission's 2021 Supporting Evidence, Chapter 9: Removing carbon from our atmosphere, sections 9.1.2 and 9.4	Withheld in full under section 18(d) of the OIA, as it is publicly available at the Commission's website. Please note: direct air capture is mentioned in sections 9.1.2 and 9.4 of the Commission's 2021 Supporting Evidence, which can be found at: Evidence-CH-9-removing-carbon-our-atmosphere.pdf (amazonaws.com) .

The Commission has a policy to proactively release OIA responses to help others have access to more information. Consequently, this letter will be published on our website with your name and contact details redacted to protect your privacy.

You have the right to seek an investigation and review by the Ombudsman of this decision. Information about how to make a complaint is available at www.ombudsman.parliament.nz or freephone 0800 802 602.

Ngā mihi

Privacy



Climate Change Commission

Climate Change Commission

Agenda Item 9b

To: Climate Change Commission
From: s 9(2)(a)
Date: 18 December 2019
Subject: Background reading on Climate Science fundamentals and the current state of knowledge

Purpose

1. It was agreed at the Climate Change Commission Board meeting on 11 December 2019 that the Secretariat will provide the Board with reading material outlining climate science fundamentals and the current state of knowledge as part of the Board Induction Plan.
2. The purpose of this material is to help the Board develop a shared understanding of key scientific principles and knowledge that will be relevant to their work.

Out of Scope

4. The attached material includes:
 - a. IPCC (2013). *Fifth Assessment Report*, Working Group 1 – The Physical Science Basis. Summary for Policy Makers.

Out of Scope

Recommendation

5. The Board notes the content of this paper.

1a.

The Fifth Assessment Report, Working Group 1 – The Physical Science Basis. Summary for Policy Makers has been withheld in full under section 18(d) of the OIA, as it is available online at: https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_SPM_FINAL.pdf.

2.

Carbon Capture and Storage- HIP team working document – withheld in full under section 9(2)(g)(i) of the OIA.

3.

From: s 9(2)(a)
Sent: Wednesday, 26 August 2020 5:27 pm
To: s 9(2)(a)
Cc: s 9(2)(a); Jo Hendy
Subject: [IN-CONFIDENCE] RE: [UNCLASSIFIED] Agenda/Time allocation/ Non-forestry removals board presso
Attachments: 200825-non-forestry removals hypothesis for board v5.pptx; 2009-HIP non-forestry removals Board Papers_Internal QA sign off_Cover page and recommendations_v5.docx; royal-society-greenhouse-gas-removal-report-2018.pdf

[IN-CONFIDENCE]

Hi

Minor tweaks s 9(2)(a) please could you give Tier 2 sign off/comments so Jo can review tomorrow? Thanks!
s 9(2)(a)

[IN-CONFIDENCE]

From: s 9(2)(a) @climatecommission.govt.nz>
Sent: Wednesday, 26 August 2020 4:28 pm
To: s 9(2)(a) @climatecommission.govt.nz>; s 9(2)(a) @climatecommission.govt.nz>; s 9(2)(a) @climatecommission.govt.nz>
Cc: s 9(2)(a) @climatecommission.govt.nz>
Subject: Re: [UNCLASSIFIED] Agenda/Time allocation/ Non-forestry removals board presso

[UNCLASSIFIED]

I think it will be tomorrow morning s 9(2)(a)

I don't think s 9(2)(a) hasn't been able to review the pack yet but copying a the Board pack for s 9(2)(a) review - cover note, presentation (including s 9(2)(a) changes) and optional Royal Society reading

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s 9(2)(a)

W climatecommission.govt.nz

From: s 9(2)(a) @climatecommission.govt.nz>
Sent: Wednesday, August 26, 2020 4:08 PM
To: s 9(2)(a) @climatecommission.govt.nz>; s 9(2)(a) @climatecommission.govt.nz>; s 9(2)(a) @climatecommission.govt.nz>

Cc: s 9(2)(a) <[redacted]@climatecommission.govt.nz>

Subject: RE: [UNCLASSIFIED] Agenda/Time allocation/ Non-forestry removals board presso

[UNCLASSIFIED]

Kia ora koutou

Just checking in if there is an eta for the slides so I can let Jo know if it will be tonight or tomorrow morning.

Thanks.

Ngā mihi

s 9(2)(a) <[redacted]>

From: s 9(2)(a) <[redacted]@climatecommission.govt.nz>

Sent: Tuesday, 25 August 2020 7:35 pm

To: s 9(2)(a) <[redacted]@climatecommission.govt.nz>; s 9(2)(a) <[redacted]>

s 9(2)(a) <[redacted]@climatecommission.govt.nz>; s 9(2)(a) <[redacted]@climatecommission.govt.nz>

Cc: s 9(2)(a) <[redacted]@climatecommission.govt.nz>; s 9(2)(a) <[redacted]>

s 9(2)(a) <[redacted]@climatecommission.govt.nz>; s 9(2)(a) <[redacted]@climatecommission.govt.nz>

Subject: Re: [UNCLASSIFIED] Agenda/Time allocation/ Non-forestry removals board presso

[UNCLASSIFIED]

Thanks s 9(2)(a) <[redacted]>

s 9(2)(a) <[redacted]> and I think 30 mins would be about right - ideally as late as possible in the session - certainly after the sessions on baselines and land use?

I'll be revising the slides to reflect s 9(2)(a) <[redacted]> feedback tonight 🦉 s 9(2)(a) <[redacted]> will review tomorrow am and then hopefully s 9(2)(a) <[redacted]> can look at them before we send to Jo COB?

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s 9(2)(a) <[redacted]>

W [\[redacted\]@climatecommission.govt.nz](mailto:[redacted]@climatecommission.govt.nz)

From: s 9(2)(a) <[redacted]@climatecommission.govt.nz>

Sent: Tuesday, August 25, 2020 12:55 PM

To: s 9(2)(a) <[redacted]@climatecommission.govt.nz>; s 9(2)(a) <[redacted]>

[redacted] <[redacted]@climatecommission.govt.nz>; s 9(2)(a) <[redacted]@climatecommission.govt.nz>

Cc: s 9(2)(a) <[redacted]@climatecommission.govt.nz>; s 9(2)(a) <[redacted]>

s 9(2)(a) <[redacted]@climatecommission.govt.nz>; s 9(2)(a) <[redacted]@climatecommission.govt.nz>

Subject: [UNCLASSIFIED] Agenda/Time allocation/ Non-forestry removals board presso

Kia ora koutou

At the moment we have 'allocated' 20 minutes for the presentation on the Agenda.
Please let us know if this will be sufficient, and if there is a preference for which day/time of day it is placed.

s 9(2)(a)

I hope you're turning the corner and feeling better every day.

Ngā mihi

s 9(2)(a)

From: s 9(2)(a) <[s 9\(2\)\(a\)@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>
Sent: Tuesday, 25 August 2020 10:16 am
To: s 9(2)(a) <[s 9\(2\)\(a\)@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>
Cc: s 9(2)(a) <[s 9\(2\)\(a\)@hancock.co.nz](mailto:s 9(2)(a)@hancock.co.nz)>; s 9(2)(a) <[s 9\(2\)\(a\)@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>; s 9(2)(a) <[s 9\(2\)\(a\)@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>
Subject: RE: [UNCLASSIFIED] FW: Non-forestry removals board presso

Morning s 9(2)(a)

Out of Scope

Jo is keen that we send some slides to the board on CCS/BECCS so it lets keep this moving along. She will ideally need them to look at by COB tomorrow.

I can be guided by how you both want to progress. I can comment on the slides now, or have a look when you have checked if there is anything more to add in light of my earlier comments. Let me know which is best.

Cheers

s 9(2)(a)

From: s 9(2)(a) <[s 9\(2\)\(a\)@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>
Sent: Tuesday, 25 August 2020 10:01 am
To: s 9(2)(a) <[s 9\(2\)\(a\)@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>
Cc: s 9(2)(a) <[s 9\(2\)\(a\)@hancock.co.nz](mailto:s 9(2)(a)@hancock.co.nz)>
Subject: RE: [UNCLASSIFIED] FW: Non-forestry removals board presso

[UNCLASSIFIED]

Thanks s 9(2)(a)

[UNCLASSIFIED]

From: s 9(2)(a) <[s 9\(2\)\(a\)@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>
Sent: Monday, 24 August 2020 9:32 pm
To: s 9(2)(a) <[s 9\(2\)\(a\)@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>
Cc: s 9(2)(a) <[s 9\(2\)\(a\)@hancock.co.nz](mailto:s 9(2)(a)@hancock.co.nz)>
Subject: RE: [UNCLASSIFIED] FW: Non-forestry removals board presso

Hi s 9(2)(a)

Thank you for working on this, and the reminder that the board needs to be able to have an informed view of the potential role of CCS/BECCS. Material could potentially go to the September Board meeting; otherwise to one of the Wednesday sessions.

There are a few different dynamics at play, so I'm afraid I can't give an answer immediately, but I've put a card on the leadership team triage board to discuss in the morning.

You are right that the board will have different levels of knowledge and interest in CCS/BECCS, so some material that sets out what the process is and what the different options are (e.g. geothermal or oil and gas reinjection, DACS and BECCS) would be valuable. It would be good for them to know some of the details like if the CO2 is compressed and injected deep enough it stays in liquid form, and whether the barriers are mainly technical or economic.

The board are also due to see some of the initial model runs at the September Board meeting. These show that even in our least ambitious 'headwinds' scenario we are projected to meet the 2050 target with not much additional technical innovation and about 1 M ha of plantation forest. In the more ambitious 'tailwinds' scenario, we can potentially get to net zero by around 2040 with the same amount of trees (1 M ha) and no CCS. Of course, once we get past 2050 we still need ongoing removals (at least for N2O) and may hit a limit on how many trees we can or want to plant, meaning CCS likely becomes an option we need to consider. To cut a long story short, it would be good for the board to have some information on CCS to round out the removals story, the question is just whether we put in the same session as the details of the model, or bring it to them the next week.

One final note, the Board will get any slide pack five days ahead of the meeting, along with the other papers. As a result we just need to make sure the pack is self-explanatory enough that the board can read and understand it before we get a chance to talk through it with them. I've had a quick look at the draft pack and can put in some comments that might help in that regard, but I'll wait until we have our leadership team chat in the morning.

Thanks again and I'll get back to you tomorrow

s 9(2)(a)

From: s 9(2)(a) <[s 9\(2\)\(a\)@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>
Sent: Monday, 24 August 2020 4:58 pm
To: s 9(2)(a) <[s 9\(2\)\(a\)@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>
Cc: s 9(2)(a) <[s 9\(2\)\(a\)@hancock.co.nz](mailto:s 9(2)(a)@hancock.co.nz)>
Subject: [UNCLASSIFIED] FW: Non-forestry removals board presso

[UNCLASSIFIED]

Hey

I think we are burying the lead – this is presenting to the Board the option of CCS/BECCS as an alternative/complement to trees (in the long term).

s 9(2)(g)(i) Can be relatively fast – 25 mins or so. But we need to explain BECCS to the Board as a concept in person (nobody understands it the first time round!) and I don't want to go later than Sept or we'll get lost in October chapters. Happy to do it not in a main Board meeting if that is easier.

Cheers

s 9(2)(a)

[UNCLASSIFIED]

From: s 9(2)(a) <[s 9\(2\)\(a\)@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>
Sent: Monday, 24 August 2020 9:54 am
To: s 9(2)(a) <[s 9\(2\)\(a\)@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>; s 9(2)(a)

s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>

Subject: Non-forestry removals board presso

s 9(2)(a) has it logged as a "possible"

Updated slides at  [200820-non-forestry removals hypothesis for board v 2.pptx](#)

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s 9(2)(a)

W [climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)

From: s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>

Sent: Friday, August 21, 2020 8:49 AM

To: s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>

Cc: s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>; s 9(2)(a)

s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>; s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>

Subject: RE: September Board Papers/Do I have everyone's papers logged?

Thanks s 9(2)(a) I'll register it as a tentative on the agenda for the moment.

From: s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>

Sent: Thursday, 20 August 2020 7:18 pm

To: s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>

Subject: Re: September Board Papers/Do I have everyone's papers logged?

thanks s 9(2)(a) I'll see if s 9(2)(a) thinks there's room for it 😊

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s 9(2)(a)

W [climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)

From: s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>

Sent: Thursday, August 20, 2020 3:56 PM

To: s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>

Cc: s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>; s 9(2)(a)

s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>; s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>; s

[@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>; s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>; s

[@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>; s 9(2)(a) [@climatecommission.govt.nz](mailto:s 9(2)(a)@climatecommission.govt.nz)>

Subject: RE: September Board Papers/Do I have everyone's papers logged?

Kia ora s 9(2)(a)

Thanks for letting me know about this item.

3a.

A thought starter on emissions removals (Attached as 200825-non-forestry removals hypothesis for board v5.pptx) – withheld in full under section 9(2)(g)(i) of the Act.

3b.

Board paper on non-forestry removals – Withheld in full under section 9(2)(g)(i) of the OIA.

3c.

The Royal Society Greenhouse Gas Removal Report 2018 is available at: <https://royalsociety.org/-/media/policy/projects/greenhouse-gas-removal/royal-society-greenhouse-gas-removal-report-2018.pdf>.

4.

From: s 9(2)(a)
To: s 9(2)(a) [Jo Hendy](#)
Cc: s 9(2)(a)
Subject: Board presentation and cover paper on non-forestry removals incorporating feedback from s 9(2)(a)
Date: Thursday, 27 August 2020 6:18:58 pm
Attachments: [2009-HIP non-forestry removals Board Papers Internal QA sign off Cover page and recommendations v6.docx](#)
[200827-non-forestry removals hypothesis for board v6.pptx](#)
[royal-society-greenhouse-gas-removal-report-2018.pdf](#)
[Outlook-cjbskks.png](#)

Apologies for the delay Jo s 9(2)(a) turned his feedback round this morning but I've only just been able to make the changes he suggested.

We're also suggesting we circulate the UK Royal Society's "Greenhouse Gas Removal" report which is recent, easy to understand and comprehensive in case any board members would like to read more about the technologies and techniques.

s 9(2)(a)



s 9(2)(a)

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Cover Note for Board Paper/Presentation

Board Meeting Date:	8-9 September	Agenda Item:	15 (Pages 1 - 16)
Author/s:	s 9(2)(a)	Sector:	HIP
Peer Reviewer:	s 9(2)(a)	Second Tier sign off:	s 9(2)(a)
Consulted: (where applicable, including name and organisation)	HIP and Land Use sector teams Gas Industry Co, Contact Energy, Genesis Energy, GNS Science, First Gas, Drax (UK biomass plant to CCS plant), Todd Energy, s 9(2)(a) s 9(2)(a) (CCS consultant to IEA)		
Title of Paper:	Non-forestry removals		
Title of any referenced previous Board Paper/s:	N/A		
Referenced Papers Link/s if required to be added to Diligent:	N/A		

Purpose

1. The purpose of the attached slidepack is to:
 - a. Provide background on the range of different greenhouse gas removal methods.
 - b. Support a discussion on:
 - i. the role carbon capture and storage could play in Aotearoa.
 - ii. the merits of developing an industry that could support a “net negative” Aotearoa in the second half of the Century.
 - c. Agree whether sufficient work has been done to allow the Commission to take a position on non-forestry removals, so that it can be included in the CCC’s first package of advice to Government.

Background

2. The IPCC has included negative emissions in budget scenarios for a 1.5 degree world.

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[IN-CONFIDENCE]

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3. Preliminary CCC modelling suggests that Aotearoa does not need to develop non-forestry negative emissions options to meet its emission reduction targets.
4. However, Aotearoa has the potential to develop negative emissions options for use in the latter half of the century.
5. Most comparator countries to Aotearoa have assumed negative emissions after 2050.
6. Aotearoa may be able to support other nations in removing legacy emissions.
7. To do this, Aotearoa would need to develop the capabilities, science and societal support.
8. A (UK) Royal Society paper has been attached as optional, additional background reading.

Action sought	Date action required by
<p>It is recommended that you:</p> <ol style="list-style-type: none"> 1. Note importance of emissions removals on other countries plans 2. Discuss opportunities for New Zealand to support other countries in removing legacy emissions and commercialise such a service 3. Agree whether sufficient work has been done to allow the Commission to take a position on non-forestry removals, so that it can be included in the CCC's first package of advice to Government. 	9/9/20

[IN-CONFIDENCE]

4b.

[UNCLASSIFIED]

A thought starter on emissions removals from carbon capture and storage

September 2020

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3

[UNCLASSIFIED]

[UNCLASSIFIED]

1. What is carbon capture and storage?

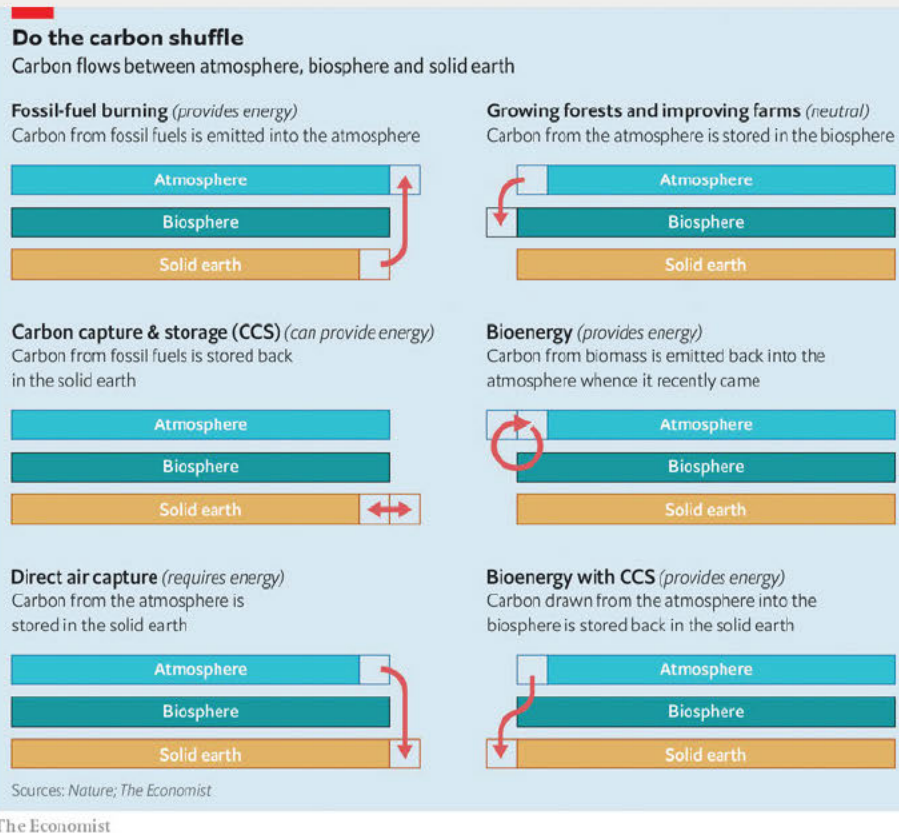
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4

[UNCLASSIFIED]

[UNCLASSIFIED]

Carbon capture



- Simplistically, carbon flows between the earth, the atmosphere and the biosphere. It can be stored either in the biosphere or in solid earth
- There are three broad approaches that can be used for removal of greenhouse gas from the atmosphere:
 1. increasing biological uptake,
 2. increasing inorganic reactions with rocks,
 3. engineering direct capture from the atmosphere
- **Forestry removals** are the most well-known type of biological uptake
- However, increasing biological uptake may alter ecosystems in undesirable ways and can require significant land area dedicated to permanent forest unless it is stored in some other environment or medium

Sources: *Climate policy needs negative carbon-dioxide emissions - The world is not remotely ready to provide them*, The Economist, 5/12/19,
Greenhouse Gas Removal method., Greenhouse gas removal, Royal Society (UK), 9/18 p. 20
 [UNCLASSIFIED]

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There are two non-biological carbon capture processes

Increasing inorganic reactions with rocks

Weathering causes natural inorganic reactions in rocks, which stores carbon in stable carbonate minerals at the earth's surface, or as stable bicarbonate ions in the ocean.

This process could be accelerated by spreading fine-grained minerals over large areas of land, or use of waste products from industry.

Using accelerated weathering to achieve large scale carbon capture is challenging because the processes are naturally very slow.

Engineering direct capture from the atmosphere

Engineered removal involves passing large volumes of air over a chemical or material that adsorbs CO₂ - direct air capture ("DAC"), followed by release of the separated and more concentrated CO₂.

Direct air capture with carbon storage ("DACCS") is the combination of DAC with CO₂ storage infrastructure or direct use of the captured CO₂ – for example in the production of cement for the built environment.

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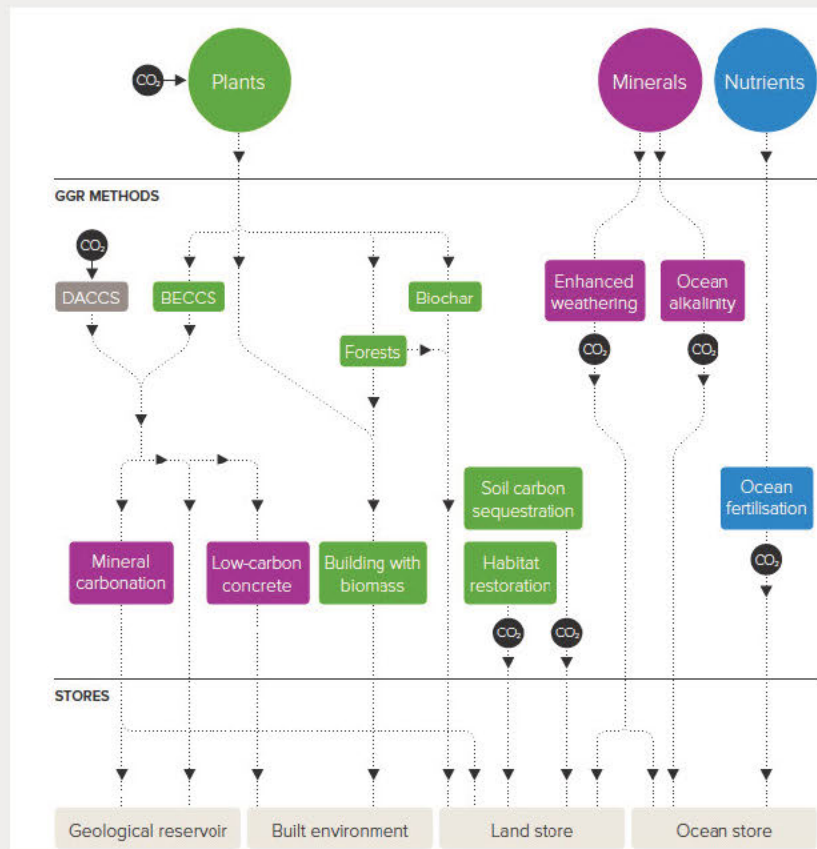
Source: *Greenhouse Gas Removal method.*, Greenhouse gas removal, Royal Society (UK), 9/18 p.20

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Carbon storage – keeping the removed carbon out of the atmosphere



There are four types of storage for captured carbon:

- Geological reservoir
- Built environment
- Land
- Ocean

Land storage can be achieved in:

- **Living vegetation** – through afforestation, reforestation and forest management as well as habitat restoration
- **Soils** - through carbon sequestration and weathering and
- **Dead vegetation** - using biochar

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Source: Greenhouse gas removal,
Royal Society (UK), 9/18

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Storing carbon in reservoirs, the ocean or the built environment

Gas reservoirs: Depleted or producing (oil and) gas reservoirs can be used as geological stores as they are known not to leak – having held methane for millennia

- Storage of CO₂ in geological reservoirs requires gas to be separated and compressed into a liquid
- Sedimentary pressure if CO₂ is injected 800m below ground, ensures that gas stays in liquid form

Like forestry, however, gas reservoirs also come with the risk of sudden release as the result of natural disasters, in particular earthquakes – to which New Zealand is prone

Ocean storage: It is possible to store carbon in the ocean by fertilisation and by increasing its alkalinity but this is expensive compared to other storage methods

Built environment: Storing carbon in the built environment, for example using low carbon concrete or building with biomass is potentially a low cost option alternative to storing carbon in the land

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Source: Greenhouse gas removal, Royal Society (UK), 9/18 p.22

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Bio-energy with carbon capture and storage (BECCS)

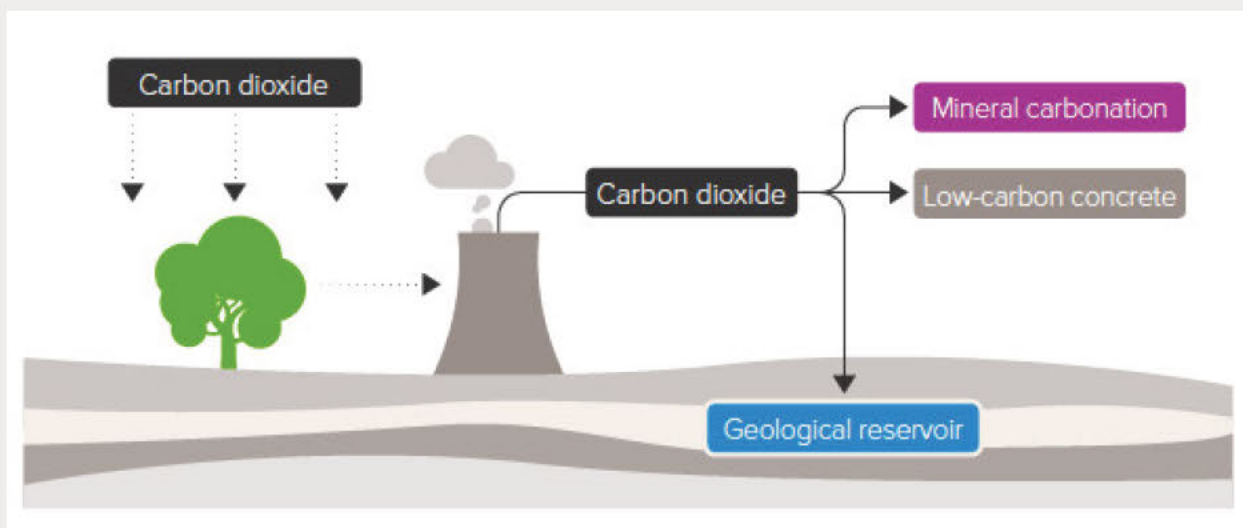
BECCS is the combination of two mitigation options:

- biomass combustion to generate energy – typically in the form of power, but potentially also as heat or liquid fuel – and
- carbon capture and storage.

Biomass includes both dedicated energy crops and waste, such as those from forestry, agricultural and municipal sources.

In this context, CCS refers to the suite of technologies that:

- capture CO₂ from the exhausts of power stations or other industrial sources
- handle and transport CO₂; and
- store the CO₂ (for example by injection in deep geological formations).



Source: Greenhouse gas removal, Royal Society (UK), 9/18, p.39

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Relative costs and maturity of removal options

GGR method	Global CO ₂ removal potential (GtCO ₂ pa)	Cost per tCO ₂ (US\$)	Technology readiness level (TRL)
Increased biological uptake			
Afforestation, reforestation and forest management ^{234,235,236}	Afforestation/ reforestation 3 – 20 forest management 1 – 2	3 – 30	8 – 9
Wetland, peatland and coastal habitat restoration ²³⁷	0.4 – 20	10 – 100	5 – 6
Soil carbon sequestration ^{238,239}	1 – 10	10 profit – 3 cost	8 – 9
Biochar ^{240,241,242}	2 – 5	0 – 200	3 – 6
Bioenergy with carbon capture and storage ^{243,244}	10	100 – 300	Bioenergy: 7 – 9 CCS: 4 – 7
Ocean fertilisation ^{245,246}	1 – 3	10 – 500	1 – 5
Building with biomass ²⁴⁷	0.5 – 1	0	8 – 9
Natural inorganic reactions			
Enhanced terrestrial weathering ^{248,249}	0.5 – 4	50 – 500	1 – 5
Mineral carbonation ²⁵⁰	–	50 – 300 (<i>ex situ</i>) 20 (<i>in situ</i>)	3 – 8
Ocean alkalinity ^{251,252}	40	70 – 200	2 – 4
Engineered removal			
Direct air capture ^{253,254,255}	0.5 – 5	200 – 600 (early stage) 100 (longer term)	4 – 7
Low-carbon concrete ^{256,257,258}	>0.1	50 – 300 (mineral carbonation)	6 – 7

Forestry is the cheapest and most mature option for carbon removal

- Managed production forests move approximately 500 tCO₂/ha into the biosphere.
- Harvested forestry is a potential source of both net-zero-carbon energy and long-term removals

Like storing carbon in the built environment, integrating biological capture with various storage methods (“bioenergy with carbon capture and storage”) is a relatively low cost and mature alternative removal option

Source: - A summary of removal potentials and costs from the literature alongside technology readiness, Greenhouse gas removal, Royal Society (UK), 9/18 p.67

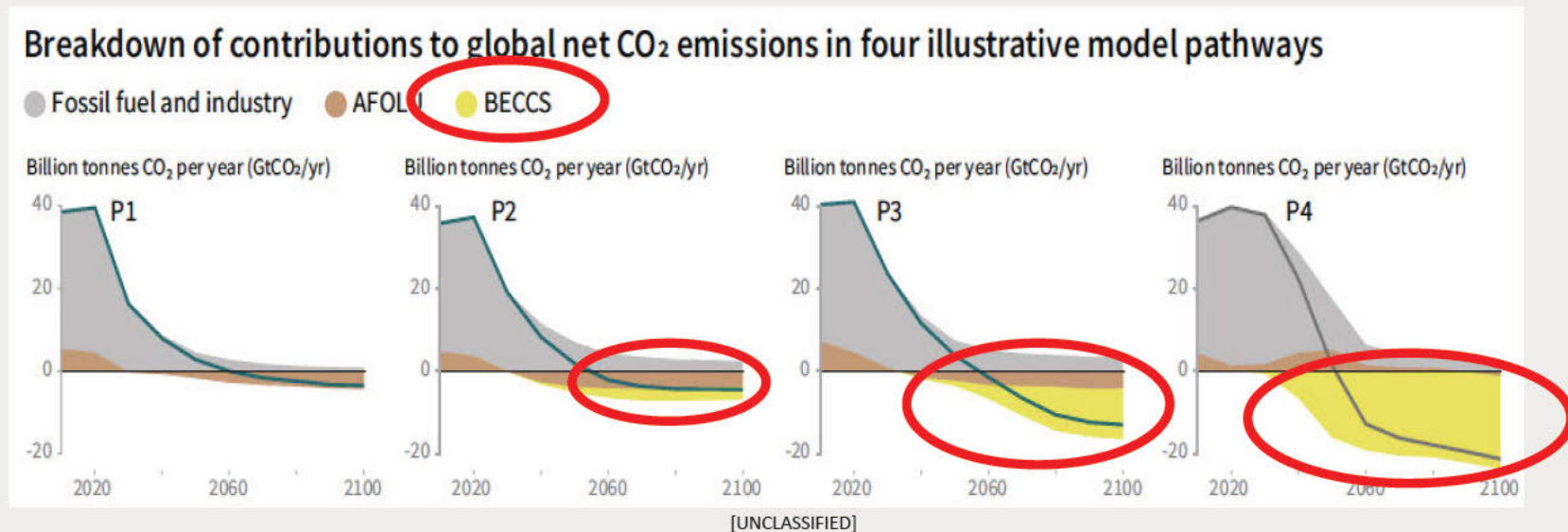
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Significant removals could be needed globally

- IPCC analysis demonstrates that even with dramatic global emissions reductions in the next 20 years, substantial deployment of negative emissions technologies are likely to be required to limit global warming to 1.5°C.



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UK CCC advice

“Most current uses of biomass do not sequester carbon and are in sectors where there are increasingly other viable low-carbon alternatives. Current uses of biomass will therefore need to change.

Over time, Government policies should assist a transition towards increased use of biomass in construction and BECCS, and away from using biofuels in surface transport, biomass for heating buildings, or biomass for generating power without CCS”

Between now and 2050, the current uses of biomass in the UK need to change:

	Most effective use today	2020s and 2030s	By 2050
 Bioeconomy	Wood in construction	Wood in construction, potentially other long-lived bio-based products (within circular economy)	
 Buildings	Biomethane, local district heating schemes and some efficient biomass boilers in rural areas	Only very limited additional use for buildings heat: niche uses in e.g. district heat and hybrid heat pumps	
 Industry	Biomass use for processes with potential future BECCS applications		BECCS in industry alongside other low-carbon solutions
 Power	Ongoing use in power sector in line with existing commitments or small scale uses	Demonstration and roll out of BECCS to make H ₂ and/or power	Biomass used for H ₂ production or power with CCS
 Transport	Liquid biofuels increasingly made from waste and lignocellulosic feedstocks	Liquid biofuel transitioning from surface transport to aviation, within limits and with CCS	Up to 10% aviation biofuel production with CCS

Maximising abatement means using biomass to sequester carbon wherever possible (opportunities to do this will increase over time)

Source: *Biomass in a low-carbon economy*, Committee on Climate Change (UK), 11/18, Pp. 12-13

[UNCLASSIFIED]

What role could carbon capture and storage play in Aotearoa?

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Specific considerations for Aotearoa

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- What's the geological potential?
 - 2009 GNS paper identified real potential in the Waikato and Onshore Taranaki - Taranaki as resources are better understood
 - 2015 GNS paper identified onshore theoretical capacity ~ 15,000 Mt (TPVE=1%),
 - actual potential will be much smaller but still enough to last for centuries
 - issues with active plate margin storage are well-understood and manageable if research and analysis starts now
- Iwi/Māori
 - There are particular considerations around land use and mana whenua, regional employment, investment opportunities, and potential impacts on papatuanuku
- Opportunity to redeploy skills from fossil fuel and geothermal industries
 - Direct applicability of reservoir engineering, reticulation and gas compression skills from oil & gas and geothermal power generation industries
 - Potential option to support “Just Transition” from hydrocarbon-based industries to net-zero carbon future (oil & gas, refining, urea, cement etc)
 - Industrial symbiosis opportunities particularly integrating geothermal and forestry resources

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What role could carbon capture play?

- Aotearoa does not need non-forestry removals to meet its carbon reduction commitments for 2050 – removals by forests can suffice
- There is likely to be a need for ongoing removals beyond 2050 (e.g. agricultural N₂O)
- Forestry, by itself, is unlikely to be sustainable removal option in the long-term (land constraints, risks around permanence) whereas BECCS could be a sustainable removal option
- There is real potential for BECCS at scale in Aotearoa, using skills from oil & gas industry combined with forestry and geological storage
- BECCS could also provide an opportunity to make Aotearoa net-carbon-negative in the second half of the century
- Developing BECCS would also provide optionality for removals but could be expensive
- Most other countries will depend on emission removals to meet their carbon reduction commitments
- Potentially, NZ could “export” reductions based on its comparative advantages and global demand

15

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What might a low regret approach look like?

- BECCS has commercial potential for NZ post 2050 but is not necessary to meet our carbon reduction commitments
- It could take decades to develop the resources and capability to provide BECCS solutions at scale
- As the NZ oil & gas industry gets smaller, technical specialists working in it will migrate overseas although their skills could be useful in developing storage for BECCS
- In the short term, low regret initiatives to preserve option for BECCS post 2050 would include
 - Begin a kōrero with Iwi/māori
 - Pilot initiatives in expired reservoirs onshore Taranaki
 - Transition planning for technical capability from oil & gas, geothermal generation and forestry industries
 - Risk modelling and mitigation planning
 - Community engagement

[UNCLASSIFIED]

4c.

The Royal Society Greenhouse Gas Removal Report 2018 is available at: <https://royalsociety.org/-/media/policy/projects/greenhouse-gas-removal/royal-society-greenhouse-gas-removal-report-2018.pdf>.

Non-forestry removals board paper

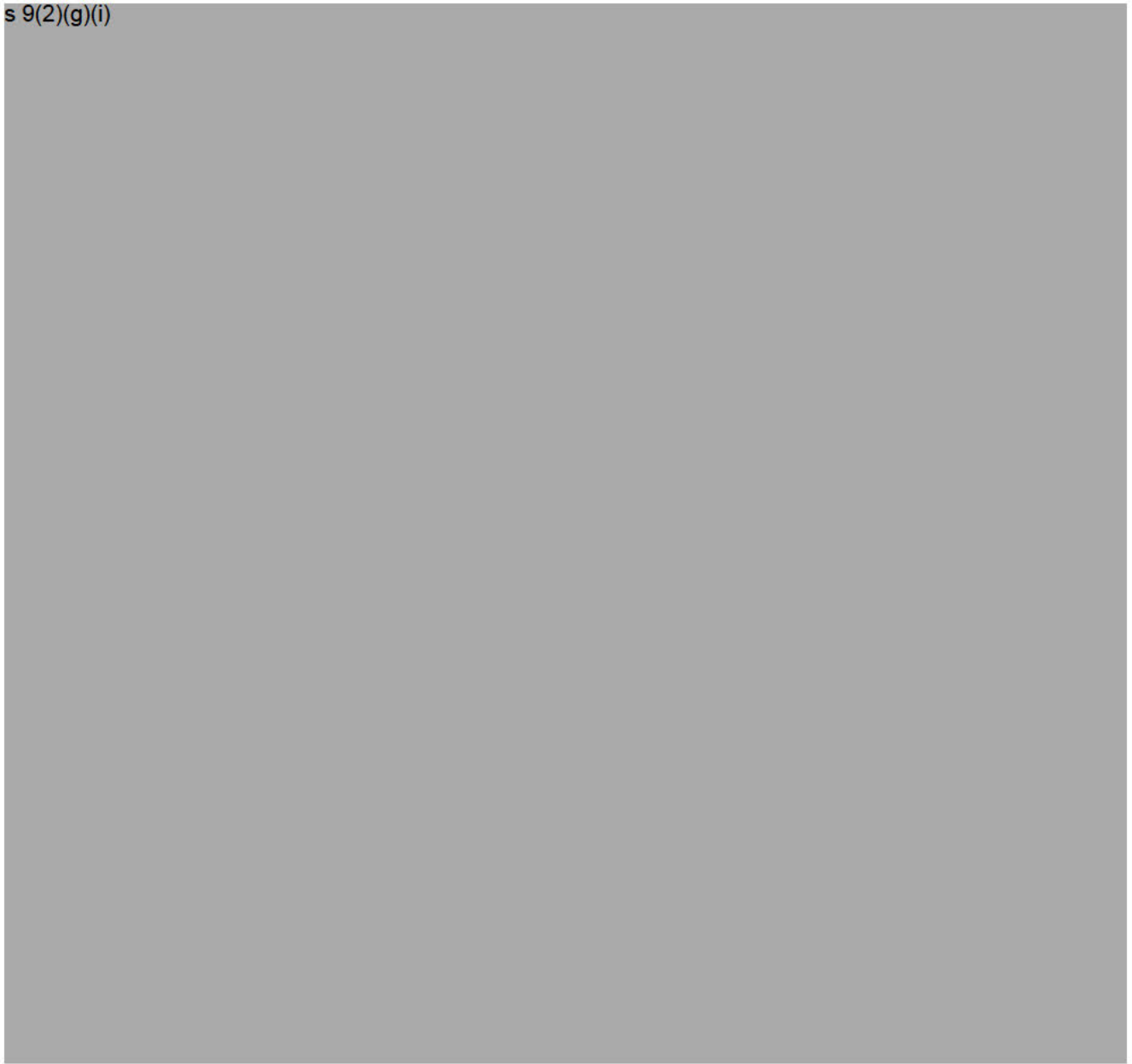
Agenda item 15, 09/09/2020

Summary of discussion:

This is an interesting idea and the board are happy to include mentions of it in our reporting. It wouldn't be appropriate to commit beyond a bare minimum of further resources to this work. We need to be careful about the framing of this to avoid perverse incentives (e.g prolonging oil and gas).

Roundtable notes:

s 9(2)(g)(i)



Summary of Comments on 4. Marked up - Non-forestry removals board presentation notes.pdf

Page: 1

s 9(2)(g)(i)

From: Rod Carr
Sent: Thursday, 10 September 2020 3:14 pm
To: Jo Hendy; s 9(2)(a)
Subject: Fwd: Climate mitigation research
Attachments: Kelleway et al 2017.pdf; Australian government-blue-carbon-2019.pdf

Follow up from my visit to Cawthron. Have not read them yet.

Rod

From: s 9(2)(a) @cawthron.org.nz>
Sent: Thursday, September 10, 2020 11:06 AM
To: Rod Carr
Cc: s 9(2)(a)
Subject: RE: Climate mitigation research

Hi Rod,
Please find attached two Australian reports detailing how blue carbon could be used as a nature based solution for emissions reduction and offsets.
Kind regards s 9(2)(a)

From: s 9(2)(a)
Sent: Thursday, 10 September 2020 11:00 AM
To: Rod Carr <Roderick.Carr@climatecommission.govt.nz>
Cc: s 9(2)(a) @cawthron.org.nz>
Subject: Climate mitigation research

Hi Rod,
It was nice to meet you at Cawthron last week.
I have attached the UK Royal Society greenhouse gas removal report (2018) that I mentioned at our meeting. This reviews the potential of greenhouse gas removal methods for the UK (and world) so I hope you find it useful.
In this regard, here is a link to a more recent publication (Beerling et al 2020 <http://lc3m.org/publications/>), outlining the carbon dioxide removal potential of Enhanced Rock Weathering on agricultural land for a selection of larger countries globally. Further information on this method (which may have future promise for NZ but to my knowledge is yet untested here) can be found at <http://lc3m.org/>
I will also send through two reports from the Australian government (Kelleway et al. 2017, Australian Government 2019) detailing how blue carbon could be used as a nature based solution for emissions reduction and offsets. Although note that NZ is currently lagging behind Australia in terms of underpinning scientific knowledge in this space.
On a personal note, it was great to see the Climate Commission in action. I did a verbal submission on the Zero Carbon Bill (with my 2-year old daughter alongside), so am pleased to see an outcome of this.
Keep up the good work and please get in touch if you have any questions or would like further information.
Kind regards, s 9(2)(a)

6a.

Towards an Emissions Reduction Fund... (Attached to email as Australian government-blue-carbon-2019.pdf) - Refused in full under section 18(d), as it is publicly available at: [Towards an Emissions Reduction Fund Method for Blue Carbon \(industry.gov.au\)](https://www.industry.gov.au/publications/towards-an-emissions-reduction-fund-method-for-blue-carbon).

6b.

Technical review of opportunities for including blue carbon...(Attached to email as Kelleway et al 2017.pdf) - Refused in full under section 18(d), as it is publicly available at: [Microsoft Word - Coastal carbon emissions technical report - Final.docx \(csiro.au\)](#).

From: Rod Carr
Sent: Sunday, 20 September 2020 2:08 pm
To: Jo Hendy; s 9(2)(a)
Subject: Fwd: Climate mitigation research
Attachments: Kelleway et al 2017.pdf; Australian government-blue-carbon-2019.pdf

This is from my visit to Cawthron.. I might have mentioned to conversation re non forestry sequestration.
 Papers attached.
 Rod

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7b.

Technical review of opportunities for including blue carbon...(Attached to email as Kelleway et al 2017.pdf) - Refused in full under section 18(d), as it is publicly available at: [Microsoft Word - Coastal carbon emissions technical report - Final.docx \(csiro.au\)](#).

8.

Draft recommendation 24 on CCS in Board papers for 23-24 November 2020 Board Meeting – withheld in full under 9(2)(g)(i)

From: Judy Lawrence
Sent: Tuesday, 1 December 2020 2:18 pm
To: Climate Commissioners; s 9(2)(a); Jo Hendy; s 9(2)(a)
Subject: I am sharing '2354.full' with you
Attachments: 2354.full.pdf

This framing is useful for post submission advice, on how transformation can happen through targeting policies that initiate response scale leading to positive cascading decarbonisation.

Judy

Get [Outlook for Android](#)

9a.

Social tipping dynamics for stabilizing Earth's climate by 2050 (Attached to email as 2354.full.pdf) is withheld in full under section 18(d) of the OIA, as it is publicly available at: [Social tipping dynamics for stabilizing Earth's climate by 2050 | PNAS](#).

From: [Media - Climate Commission](#)
To: [All Staff](#); [Climate Commissioners](#)
Subject: 08/04/21 - Full media report
Date: Thursday, 8 April 2021 10:02:42 am
Attachments: [8b450527-9378-4202-8377-49e86448cab3.png](#)



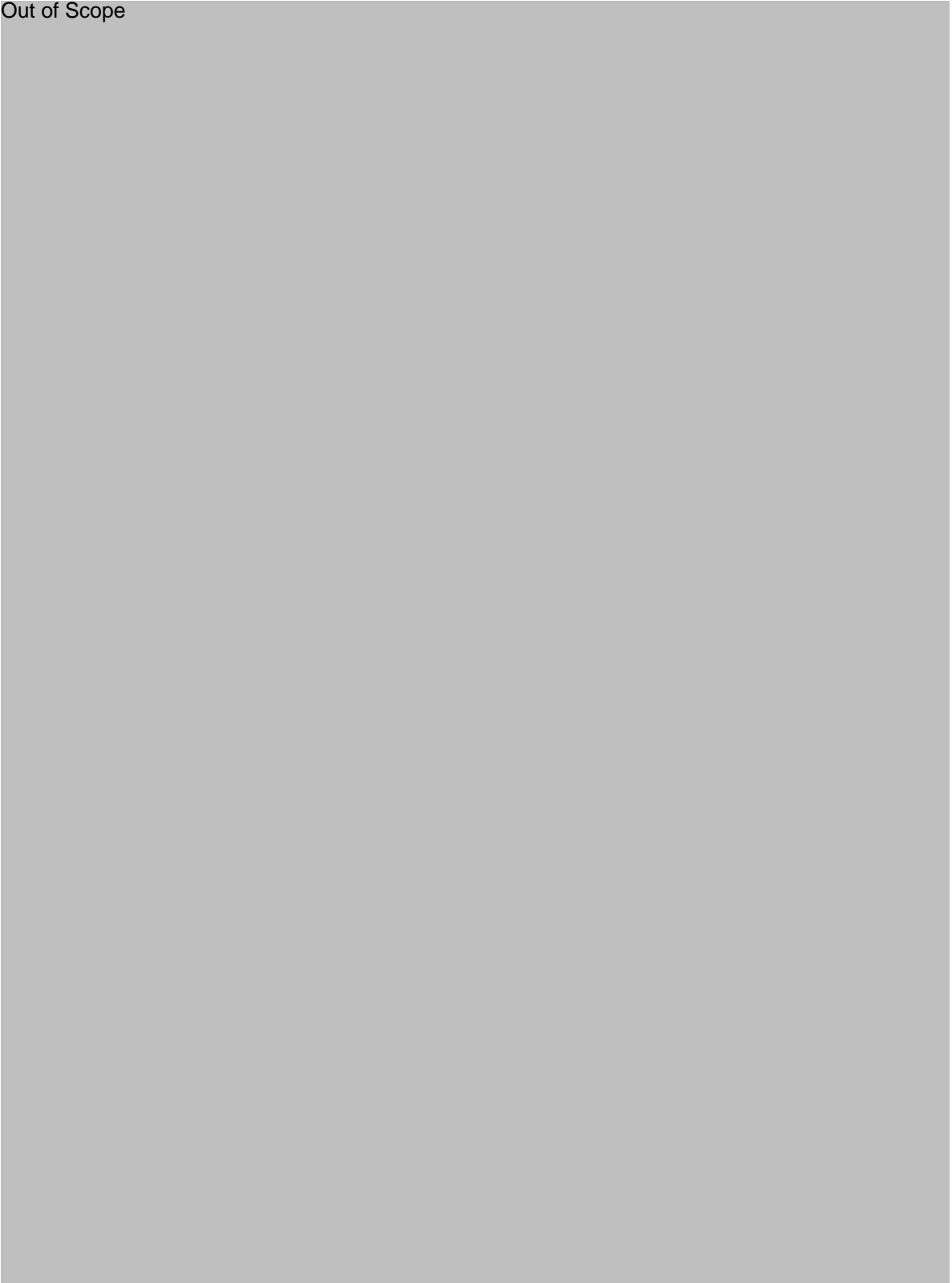
[Climate Change Commission](#) (21), [Members](#) (2), [Agriculture](#) (2), [Energy + Transport](#) (17), [Climate change](#) (27)

Climate Change Commission

Out of Scope



Out of Scope



'Genial genius' alerted world to threats of nuclear winter and ozone depletion

From Manawatu Standard

Published 05:00 08/04/2021

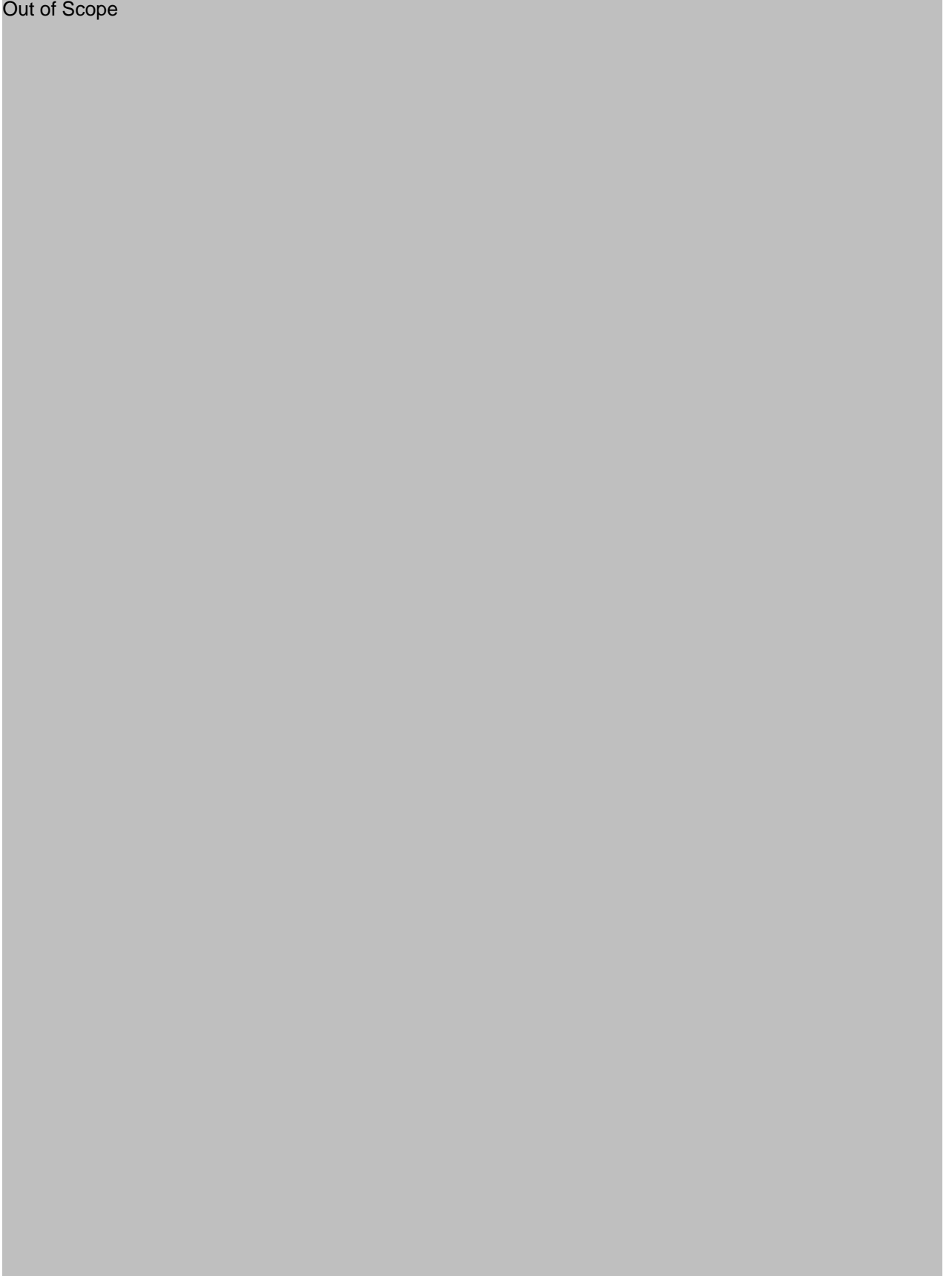
Also from [Waikato Times print edition](#), [Timaru Herald print edition](#), [The Press print edition](#), [Southland Times print edition](#), [Taranaki Daily News print edition](#)

Section: News & National **On Page:** 20 Paul Crutzen atmospheric scientist b December 3, 1933 d January 28, 2021 ----- Contact us Do you know someone who deserves a Life Story? Email obituaries@dompost.co.nz ----- Ironically for a man of serene

and gentle demeanour, Paul Crutzen was best known for an abrupt interjection.

... It seemed obvious to Crutzen that that period of stability was now over; not only had **greenhouse gas emissions** warmed the planet by more than half a degree since pre-industrial times, a far larger spike than any natural variation in the Holocene, but humanity had radically altered the planet in many other ways - by cutting down forests, driving species to extinction, and dousing crops with fertiliser. ... Specifically, he feared that if we did not cut our **greenhouse gas emissions** rapidly enough to avoid disruptive climate change, we might have to turn down the planet's thermostat by a risky method called "geoengineering".

Out of Scope



The Commission's 2021 Supporting Evidence is withheld in full under section 18(d) of the OIA, as it is publicly available at the Commission's website. Please note: direct air capture is mentioned in sections 9.1.2 and 9.4 of the Commission's 2021 Supporting Evidence, which can be found at: <https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/Evidence-21/Evidence-CH-9-removing-carbon-our-atmosphere.pdf>.