



Coastal Hazards Working Group NOTES ATTACHMENTS

Date: Friday 4 February 2022
Time: 1.33pm
Venue: Council Chambers, Level 2, Civic Offices, 53 Hereford Street, Christchurch

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Coastal Hazards 2021

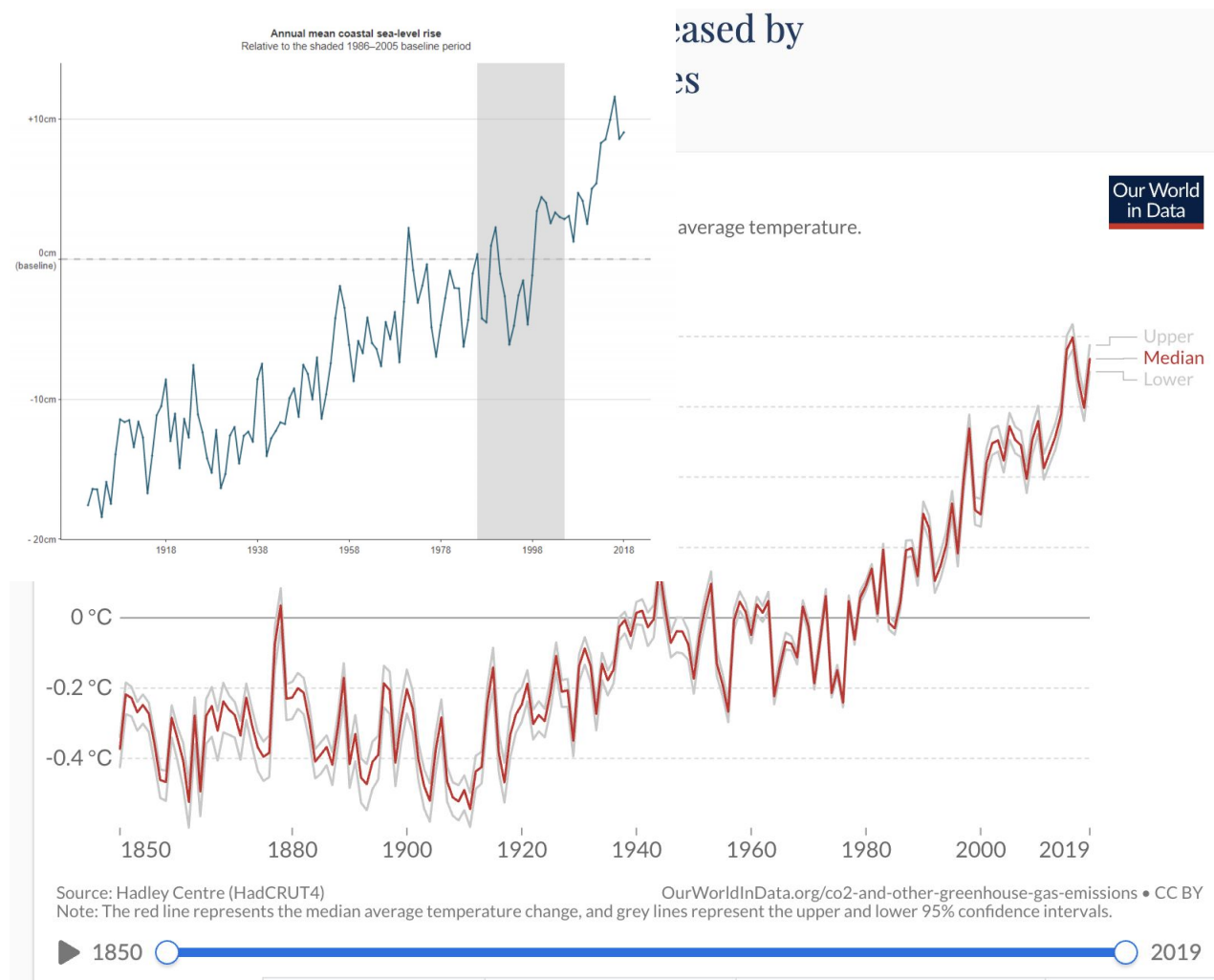
Intro

**The world is warming and
the sea is rising.**

We need to be thinking
about and planning for the
possible consequences.

https://www.stats.govt.nz/indicators/coastal-sea-level-rise?fbclid=IwAR2Vtn77qpzLACsRyiUv4oDmFwv_T59I9L7snYsQ2s_A4Aewldo0w610Vyo

<https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions>

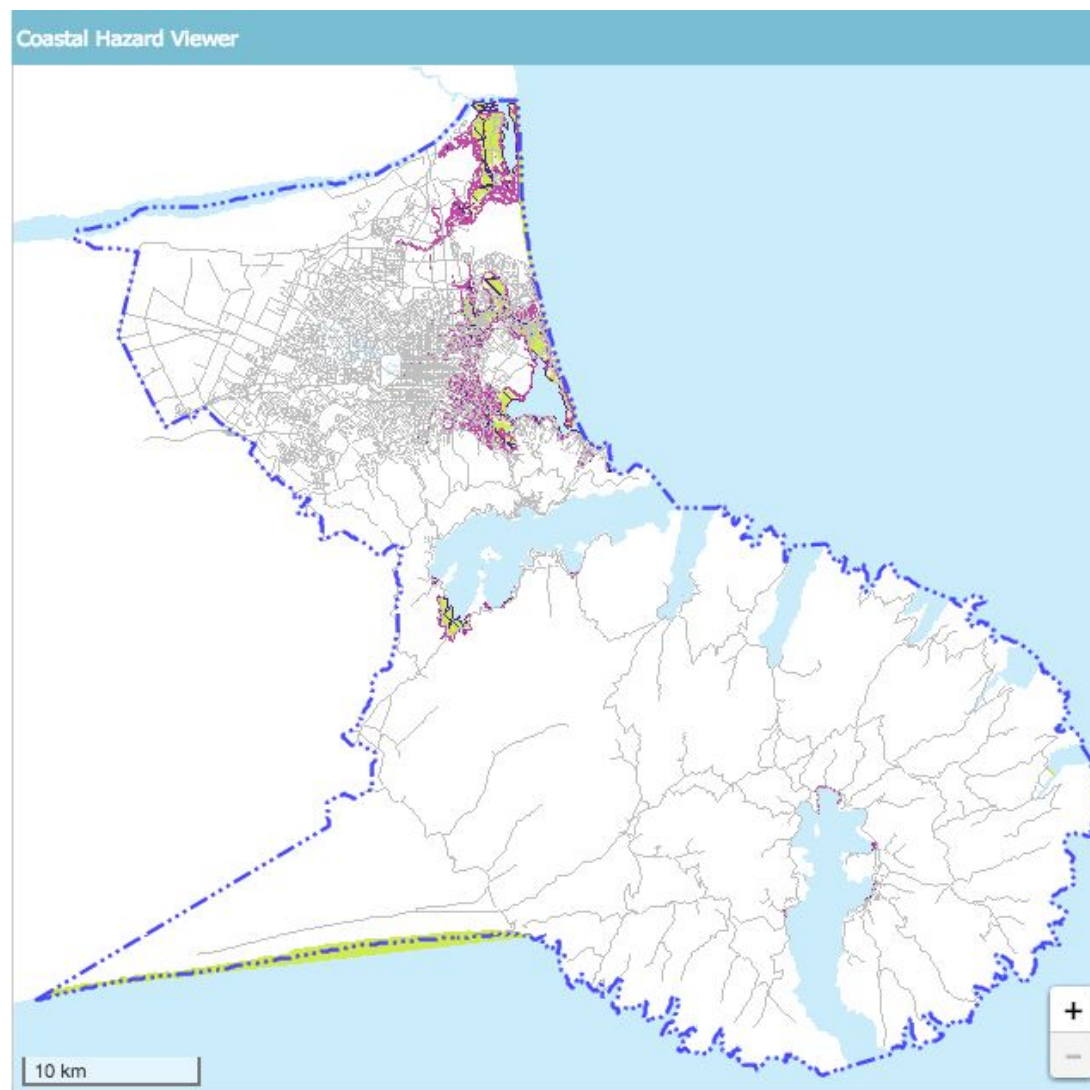


Understanding Liability and Costs - the balancing act



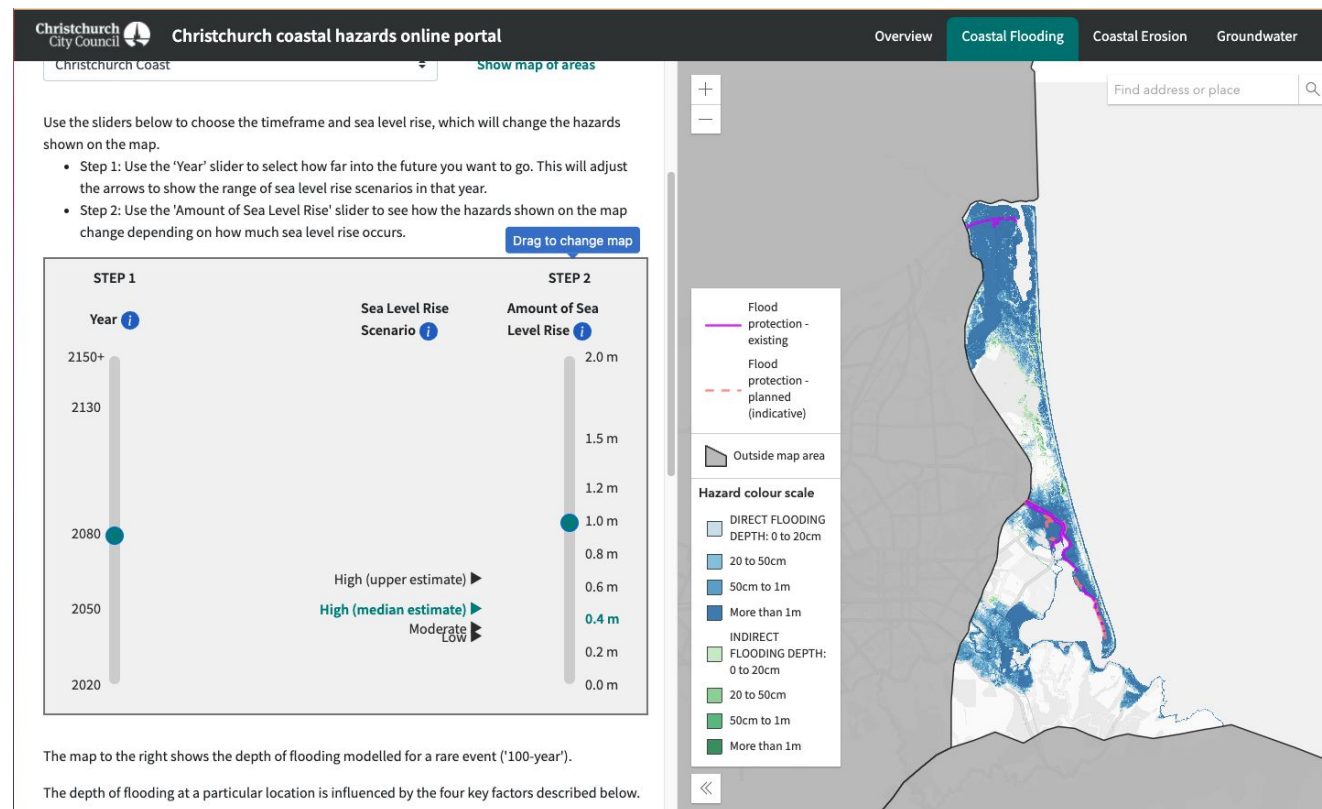
Areas affected and what went wrong last time

- 1m Sea Level Rise **RCP8.5**
- + 1 in 500 year flood event
- + 16% increased rain
- + 1 in 50 year high tide event

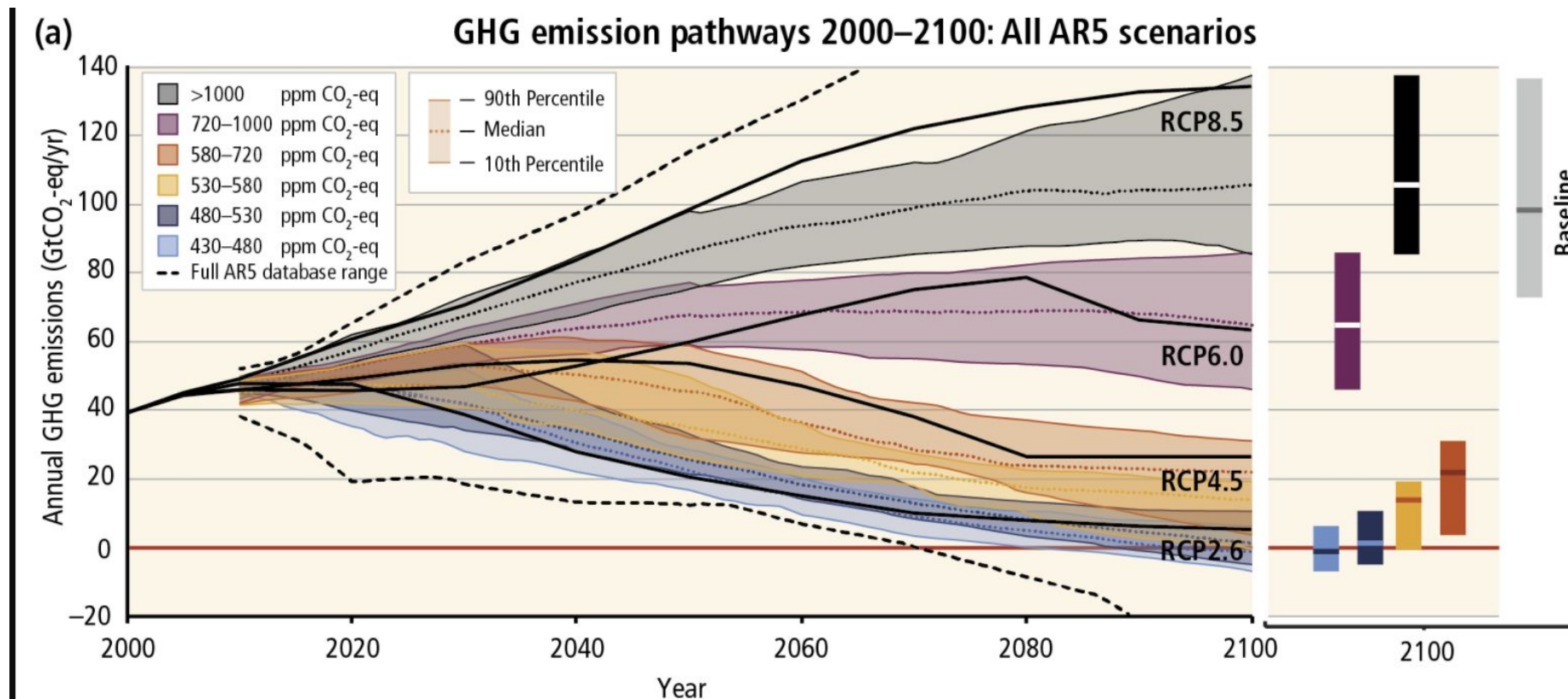


What is better this time, remaining concerns and some suggestions

- Continued use of RCP8.5
- Lack of clarity around other assumptions
- No city as a whole view



What is RCP8.5?



https://www.ipcc.ch/site/assets/uploads/2018/02/SPM.11_rev1-01.png

IPCC have come out and said 8.5 is unlikely

“In general, no likelihood is attached to the scenarios assessed in this Report. ... “... However, the likelihood of high emission scenarios such as RCP8.5 or SSP5-8.5 is considered low in light of recent developments in the energy sector (Hausfather and Peters, 2020a, 2020b)4”

IPCC AR6 Section 4.2.2

“... The high-end scenarios RCP8.5 or SSP5-8.5 have recently been argued to be implausible to unfold (e.g., (Hausfather and Peters, 2020); However, where relevant we show results for SSP5-8.5, for example to enable backwards compatibility with AR5, for comparison between emission-driven and concentration-driven simulations, and because there is greater data availability of daily output for SSP5-8.5. When presenting low-likelihood high-warming storylines we also show results from the high-end SSP5-8.5 scenario.

Policy 24: Identification of coastal hazards

- (1) *Identify areas in the coastal environment that are potentially affected by coastal hazards (including tsunami), giving priority to the identification of areas at high risk of being affected. Hazard risks, over at least 100 years, are to be assessed having regard to:*
- (a) *physical drivers and processes that cause coastal change including sea level rise;*
 - (b) *short-term and long-term natural dynamic fluctuations of erosion and accretion;*

Policy 24 lays the foundation for risk-based coastal hazard management. Areas that will potentially be affected by coastal hazards are to be identified (giving priority to high-risk areas). Hazard risks over at least the next 100 years are to be assessed for those areas (having regard to a range of factors that affect hazard risks and the effects of climate change on each of those factors). The identification of these risks is to take into account national guidance and the best available information on the likely effects of climate change on the region or district.

- (g) *the extent and permanence of built development; and*
- (h) *the effects of climate change on:*
 - (i) *matters (a) to (g) above;*
 - (ii) *storm frequency, intensity and surges; and*
 - (iii) *coastal sediment dynamics;*

taking into account national guidance and the best available information on the likely effects of climate change on the region or district.

<https://www.doc.govt.nz/Documents/conservation/marine-and-coastal/coastal-management/guidance/policy-24-to-27.pdf>

Policy 25: Subdivision, use, and development in areas of coastal hazard risk

In areas potentially affected by coastal hazards over at least the next 100 years:

- (a) avoid increasing the risk of social, environmental and economic harm from coastal hazards;*
- (b) avoid redevelopment, or change in land use, that would increase the risk of adverse effects from coastal hazards;*
- (c) encourage redevelopment, or change in land use, where that would reduce the risk of adverse effects from coastal hazards, including managed retreat by relocation or removal of existing structures or their abandonment in extreme circumstances, and designing for relocatability or recoverability from hazard events;*
- (d) encourage the location of infrastructure away from areas of hazard risk where practicable;*
- (e) discourage hard protection structures and promote the use of alternatives to them, including natural defences; and*
- (f) consider the potential effects of tsunamis and how to avoid or mitigate them.*

[The NZCPS 2010 glossary states that ‘Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood of occurrence (AS/NZ ISO 31000:2009 Risk management—Principles and guidelines, November 2009)’.]

T&T Coastal Hazard Assessment 2021

The national guidance recommends focussing on the 'High' sea level rise scenario (the technical term used in climate science is 'RCP8.5 M') for the first stage of risk screening. This reflects global emissions continuing at the present rate and is most aligned with our current trajectory of emissions. For more detailed risk assessment and adaptation planning the full range of scenarios should be considered to understand the range of possible futures. As explained in Section 12, the 2021 CHA looks at many different amounts of sea level rise which provide good coverage across the range of these four recommended scenarios

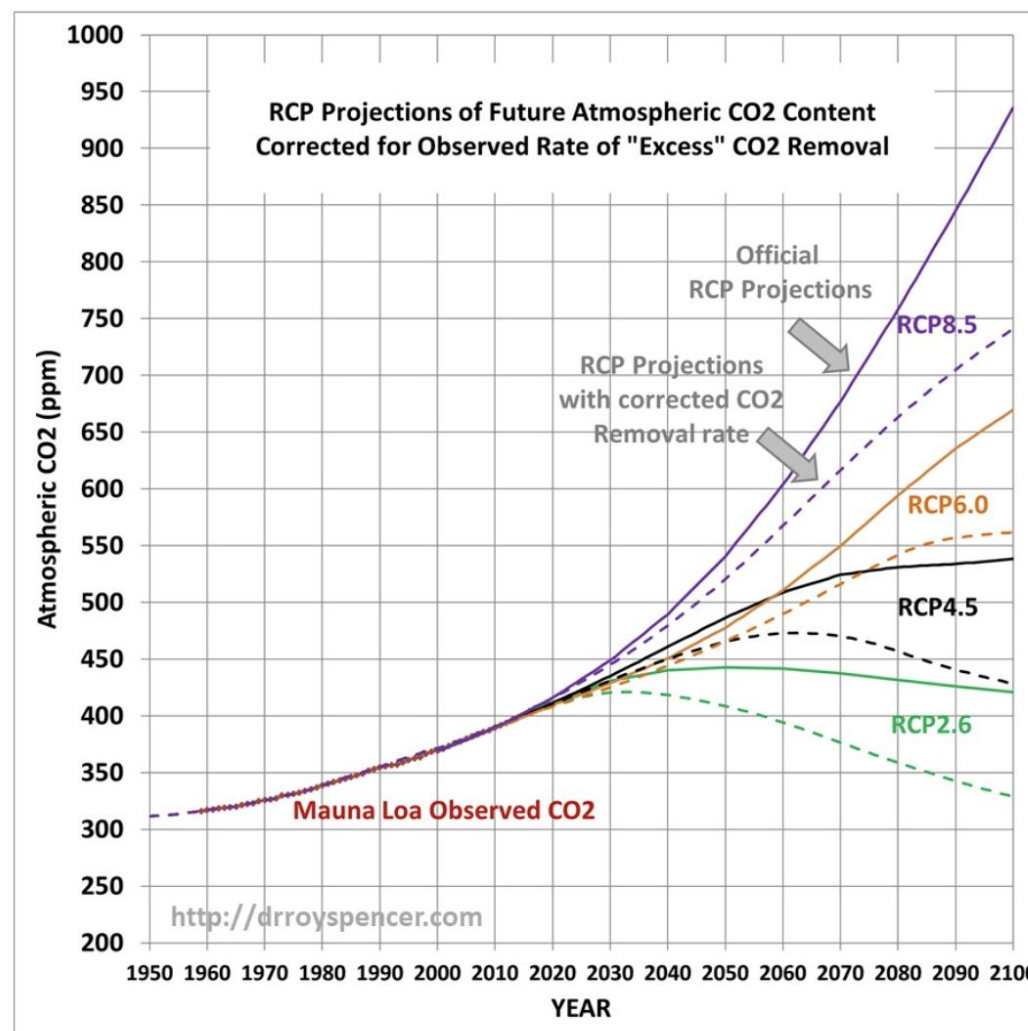
It is predicted that New Zealand will experience 30cm of sea level rise by 2050, 50cm of rise by 2075 and 1m of rise by 2151.

T&T coastal adaptation pathways pg6

- [T&T Coastal Hazard Assessment 2021](#)

**“We are currently on the
RCP8.5 path way”**

(We are also on 6.0, 4.5 and 2.6)



<https://www.drroyspencer.com/2020/02/nature-has-been-removing-excess-co2-4x-faster-than-ipcc-models/>

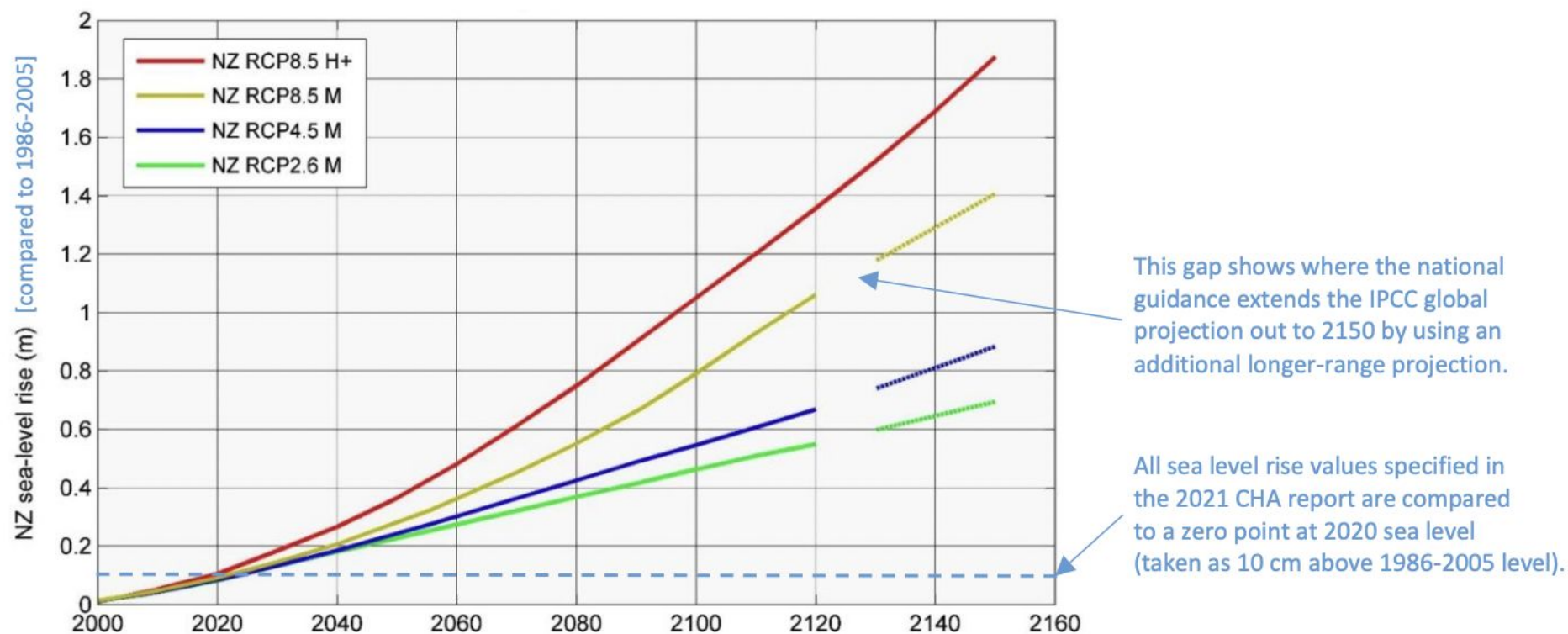


Figure 7.1: Sea level rise projections for New Zealand (relative to 1986-2005) adapted from national guidance.

Table 7.1: Sea level rise scenarios from the national guidance.

High (upper estimate) (Technical term = RCP8.5 H+)	
<i>Emissions:</i>	This scenario assumes continued high emissions, with annual global climate pollution continuing to climb through most of the century if we don't act effectively to reduce emissions. High population growth is also a factor. Consistent with 3 or 4°C of warming.
<i>Sea level response:</i>	This upper estimate 'H+' scenario is at the upper end of the likely range for sea level response to emissions. This reflects the possibility of future surprises, including possible instability of polar ice sheets. In short, warmer temperatures could have a strong effect on sea levels.
<i>Adaptation:</i>	This scenario will be used as a 'stress test' in adaptation planning, to understand implications of sea level rise towards the top end of the projected range.
High (median estimate) (Technical term = RCP8.5 M)	
<i>Emissions:</i>	Continued high emissions (same as 'RCP8.5' scenario above).
<i>Sea level response:</i>	This scenario, and the other 'M' scenarios below, assume that warming has a more moderate effect on sea levels. It uses a projection from the middle of the likely range for sea level response to warming caused by emissions.
<i>Adaptation:</i>	This scenario will be the main point of reference for adaptation planning as it is most aligned with our current trajectory of emissions.

T&T pg6

MFE Guidance

RCP8.5 – continuing high emission baseline scenario (Riahi et al, 2011), with no effective global emissions reduction. Comprises a rising radiative forcing pathway, with emissions stabilised soon after 2100 (figure 22). RCP8.5 provides a baseline pathway to compare the effectiveness of different levels of emission-reduction policies. An 'RCP8.5 world' would exhibit slow rates of economic development, slow uptake of technology. World population estimated to reach around 13 billion.

<https://environment.govt.nz/assets/Publications/Files/coastal-hazards-guide-final.pdf> pg 87

RPC 8.5 - the 'goto' scenario

where a single scenario is required, we again take advice from MfE and IPCC who do explicitly advise that RCP8.5 is the scenario **most aligned** with the current trajectory of global emissions.

CCC letter [thread link](#)

COMMENT | 29 January 2020

Emissions – the ‘business as usual’ story is misleading

Stop using the worst-case scenario for climate warming as the most likely outcome – more-realistic baselines make for better policy.

[Zeke Hausfather](#) & [Glen P. Peters](#)



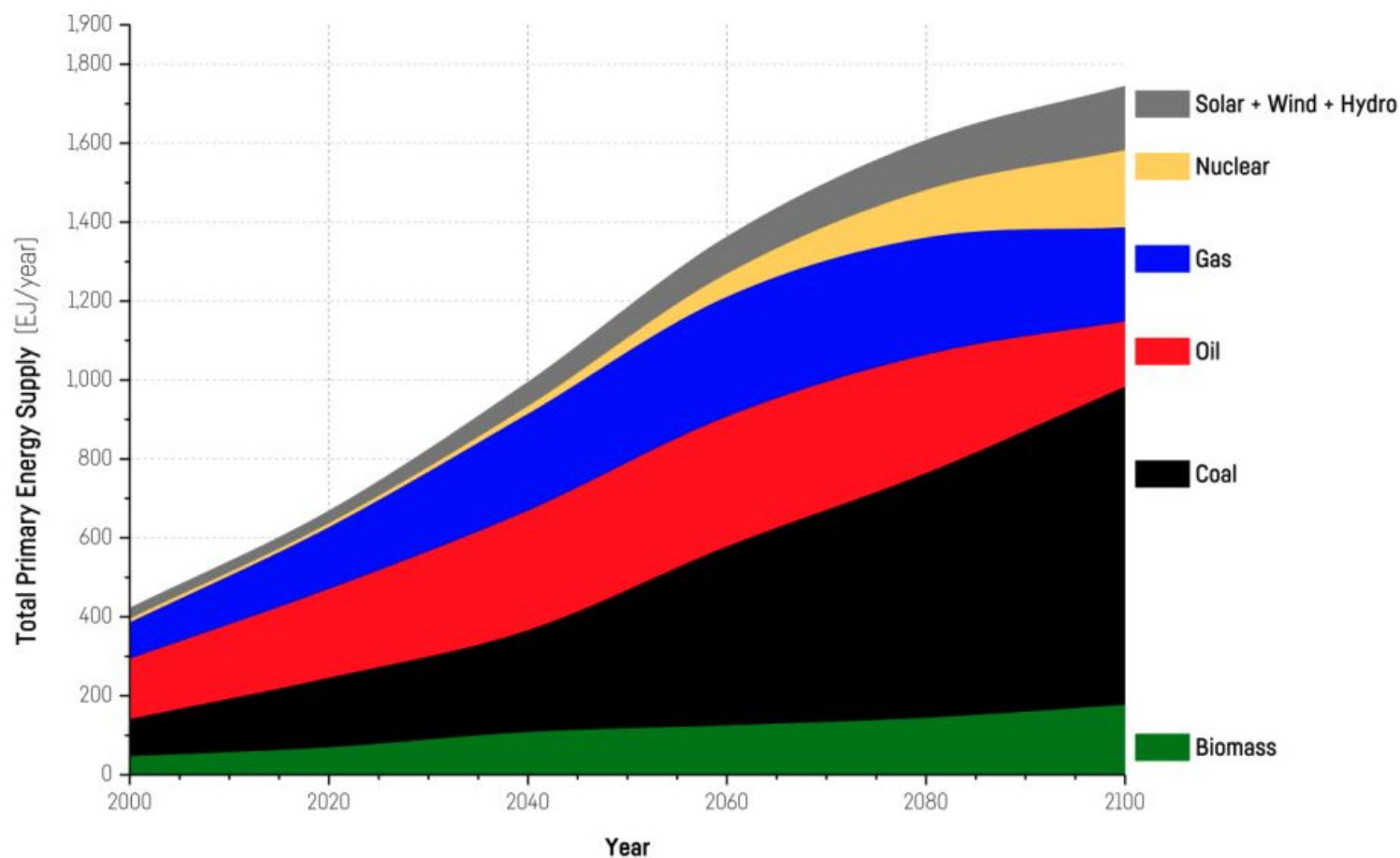
Emission pathways to get to RCP8.5 generally require an unprecedented **fivefold increase in coal use** by the end of the century, an **amount larger than some estimates of recoverable coal reserves**.



<https://www.nature.com/articles/d41586-020-00177-3>

Justin Ritchie

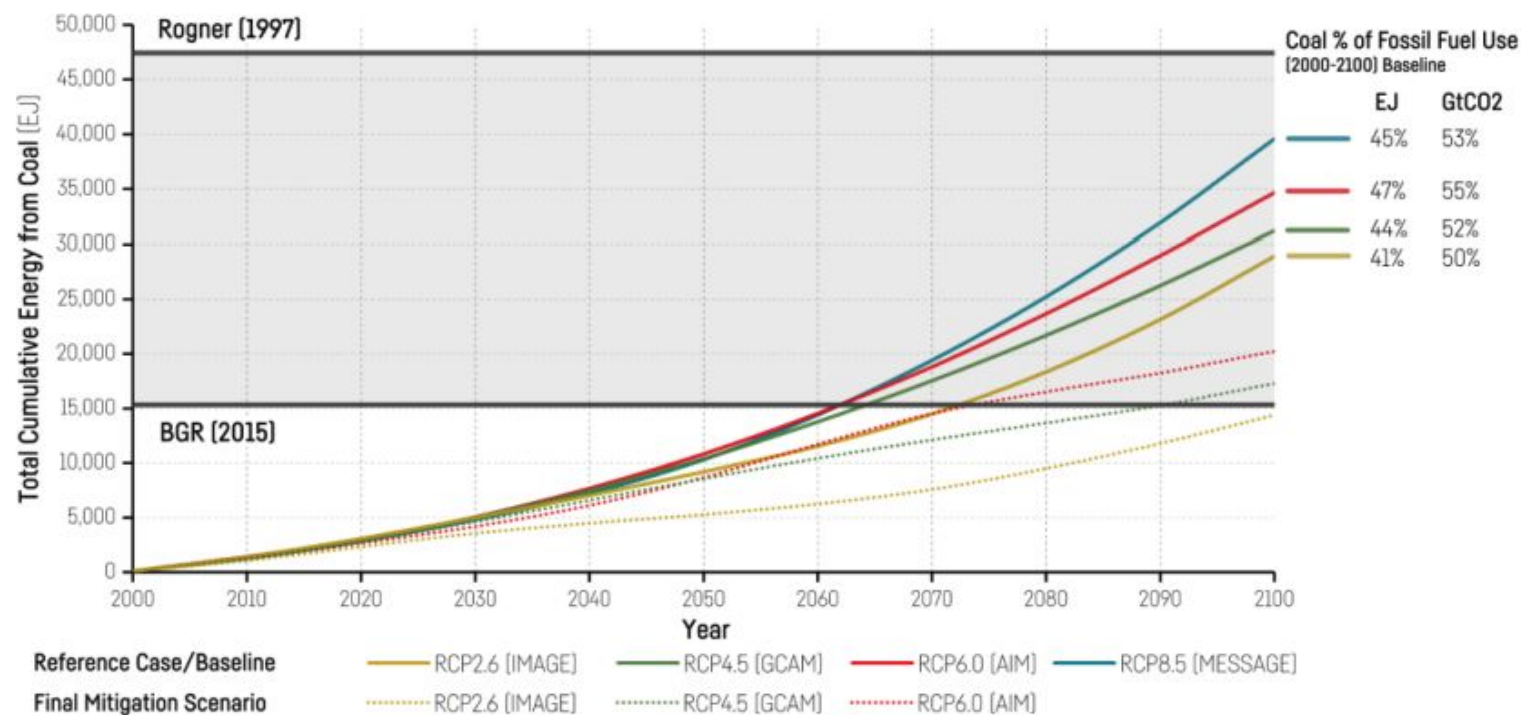
[UBC Institute for the Oceans
and Fisheries](#)



<https://www.sciencedirect.com/science/article/pii/S0140988317301226?via%3Dihub>

Justin Ritchie and Hadi Dowlatabadi

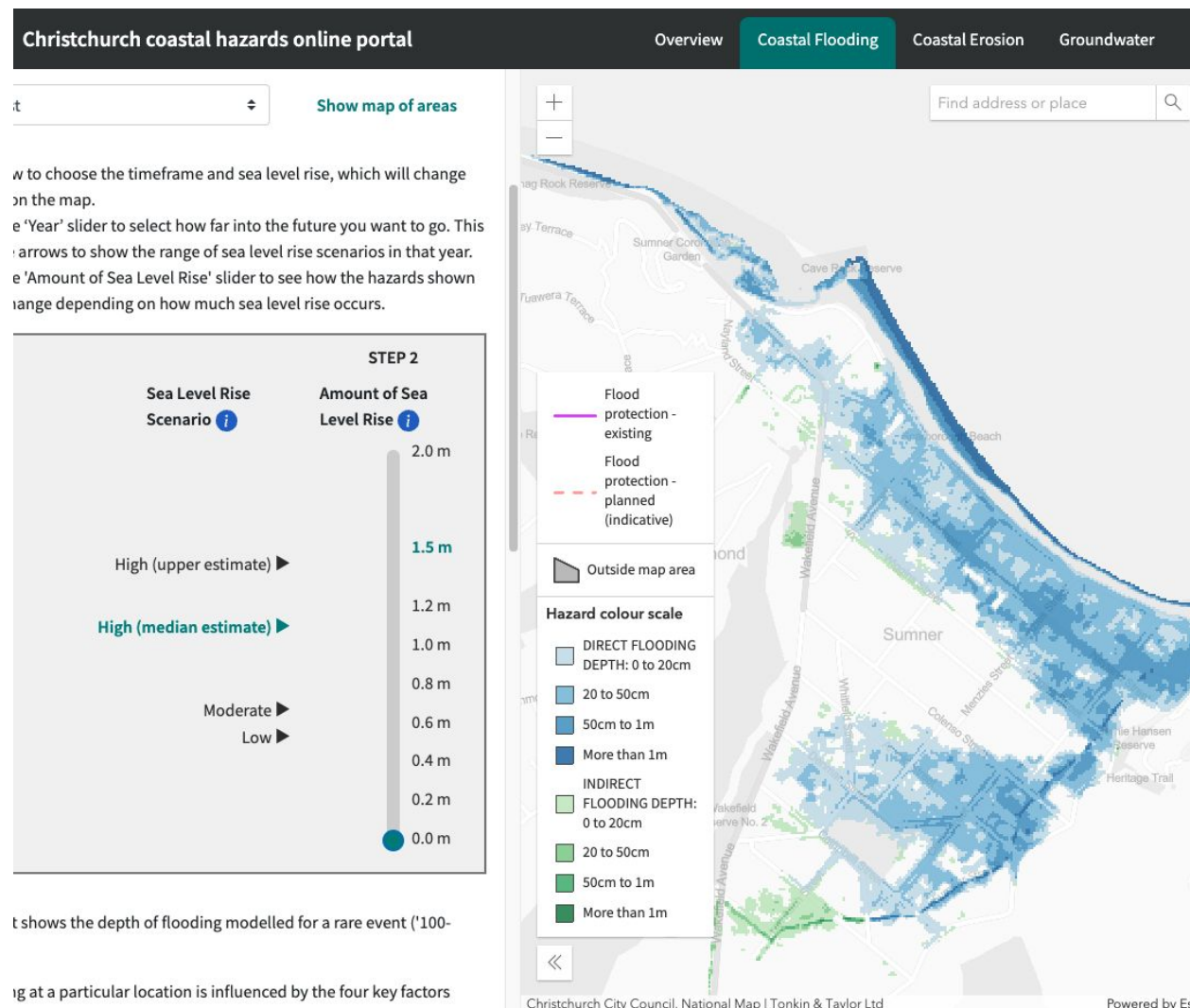
RCP 8.5 needs more coal than exists on earth



<https://www.sciencedirect.com/science/article/pii/S0140988317301226?via%3DiHub>

Justin Ritchie and Hadi Dowlatabadi

- 1m Sea Level Rise
- + 1 in 500 year flood event
- + 16% increased rain
- + 1 in 50 year high tide event
- Happening in the middle of the night



<https://gis.ccc.govt.nz/hazard-viewer/coastal-flooding>

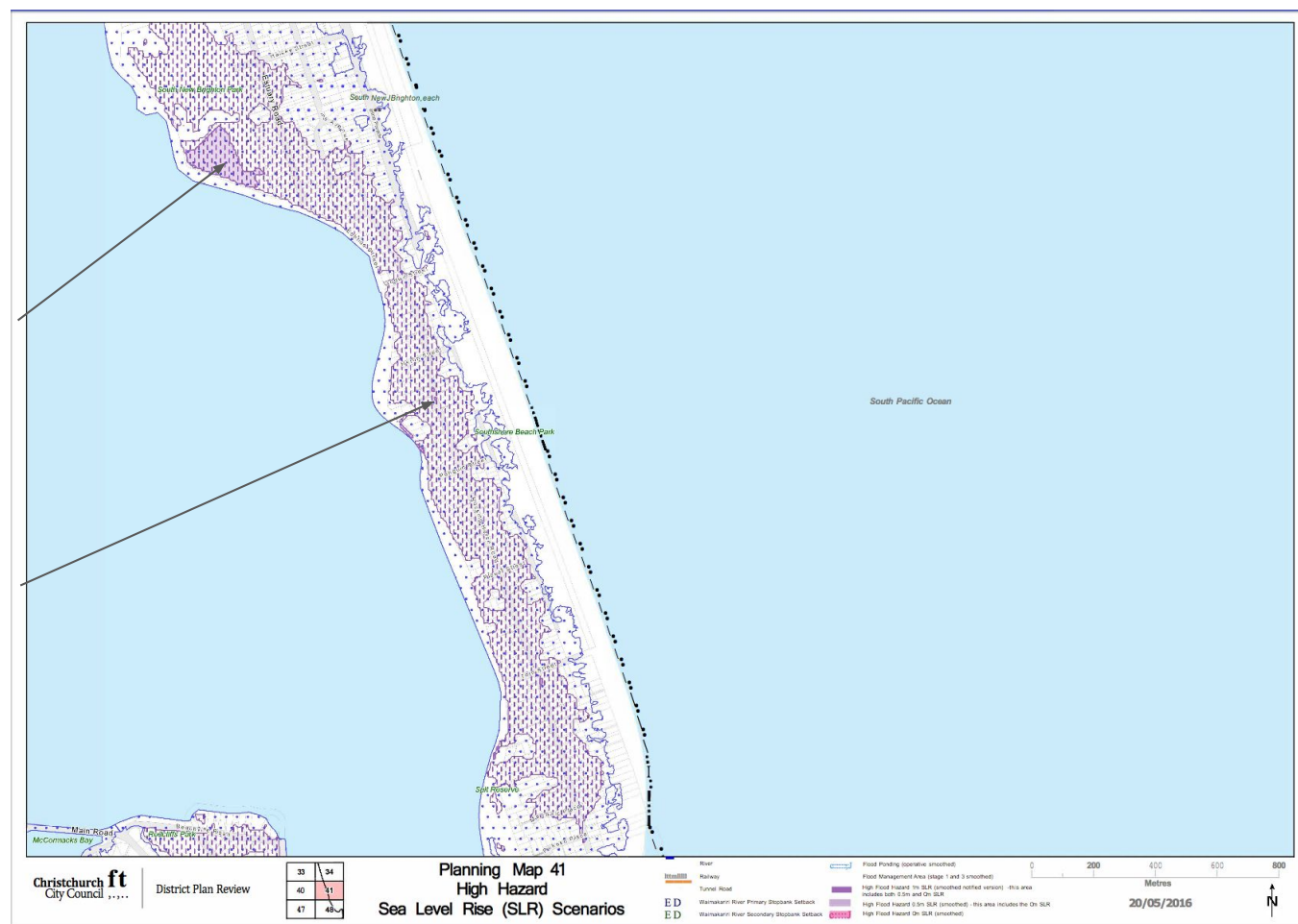
t shows the depth of flooding modelled for a rare event ('100-

ing at a particular location is influenced by the four key factors

2015 CCC model done for the IHP

Area affected by .5m SLR

Area affected by 1m SLR





Who are the Coastal Panel?

A diverse group of community and rūnanga representatives from each Adaptation Area. Some city-wide representation will also be included as well as youth voices. There is one Coastal Panel per Adaptation Area.

The role of the Coastal Panel is to provide informed recommendations to Council for adaptation plans that allow communities within the Adaptation Area that are impacted by coastal hazards, to respond to changes over time.

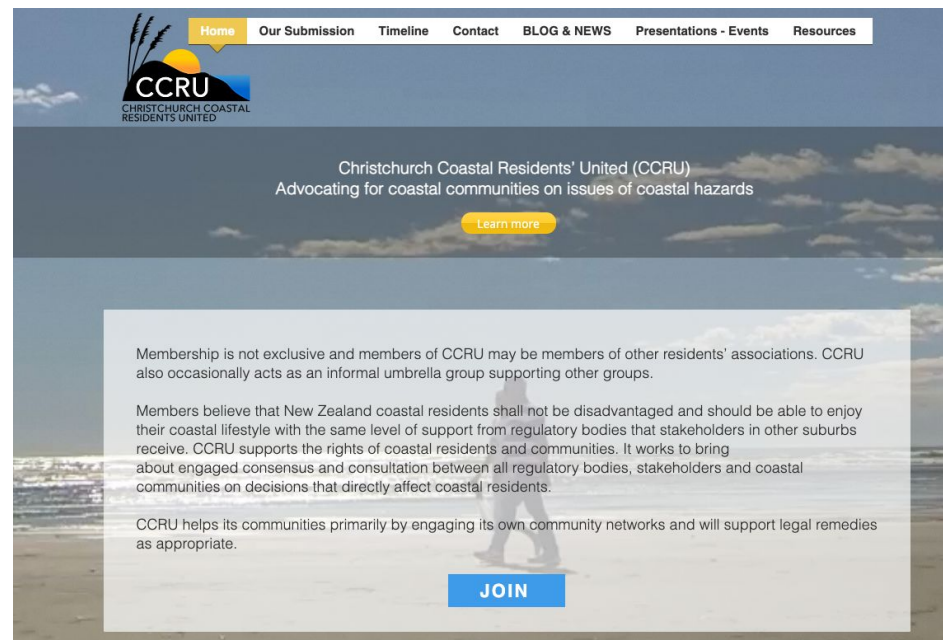


Who are the STAG?

A specialist and technical forum that assists the Council and Coastal Panel with the creation of adaptation pathways.

Members are experts in their fields from across a number of agencies, and are able to provide information, advice and guidance to support Coastal Panel decision-making.

1. RCP 8.5 should to be removed from the hazard assessment.
2. The latest science needs to be used.
3. If RPC 8.5 can't be removed, language in the report should be amended to be more balanced.
4. Model assumptions need to be (more clearly) published.
5. Affected communities should have equal rights with CCC when it comes to appointing members to the STAG.
6. Affected communities should be able to appoint all members to community panels.
7. More time for feedback is needed.



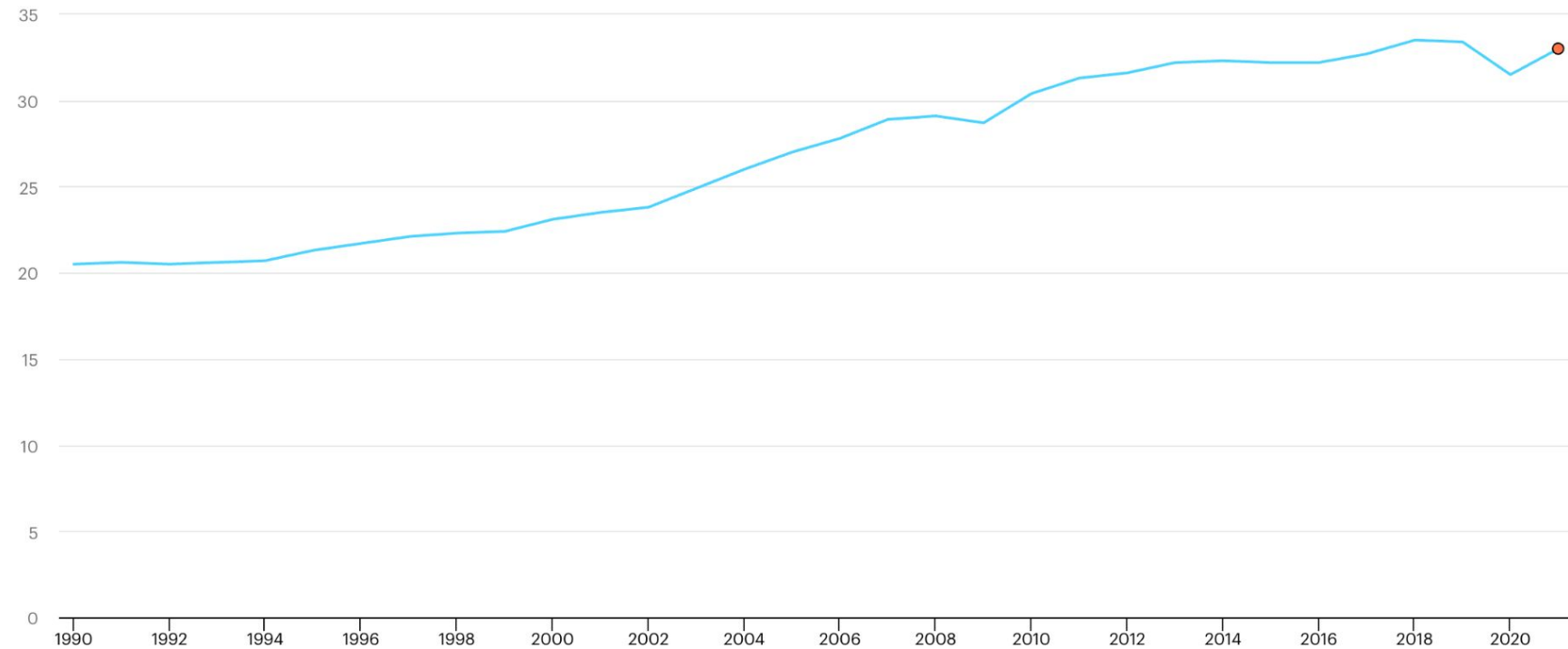
Extra Slides

References

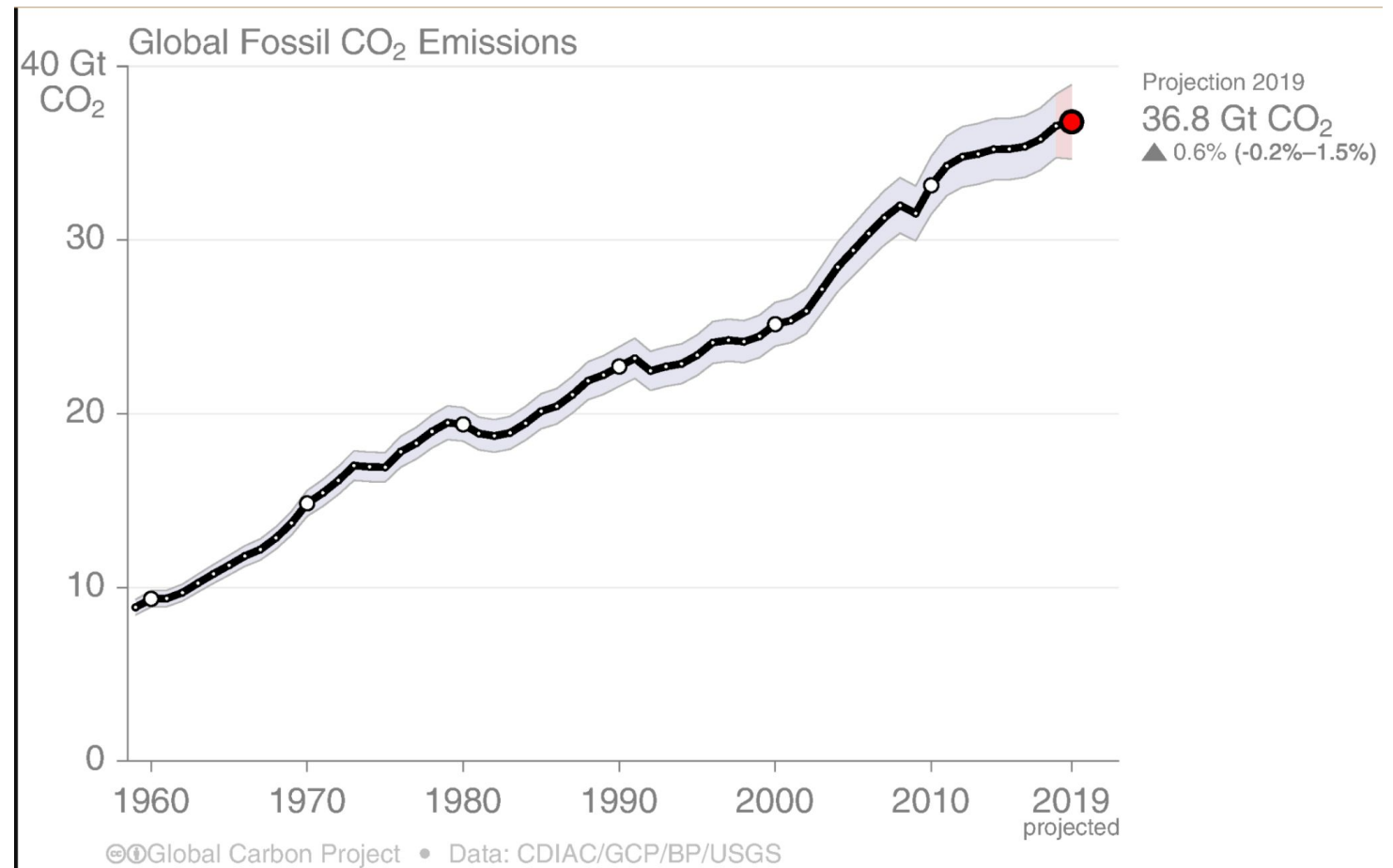
- [Kapiti Folder](#)
 - [Kapiti addendum](#)
 - [Jacobs Methodology](#)
 - [Jacobs response](#)
- [IPCC AR6](#)
- [IPCC AR5](#)
 - [AR5 Report](#)
- [MFE guidance](#)
- [Coastal Hazard Assessment - Full Technical Report \[PDF, 140 MB\]](#) T&T
- [Coastal Hazard Assessment - Summary Report \[PDF, 4.8 MB\]](#)
- [Christchurch City Council Multi-Hazard Baseline Modelling Joint Risks of Pluvial and Tidal Flooding](#) GHD
 - [CCC adaptation planning framework](#)
 - [Coastal Hazards Plan Change](#)
- [Peg bay sand budget report](#)
- [NIWA Rainfall report](#)
- [NOAA Global Co2 monitoring](#)
- [COLE SLR acceleration thesis](#)
- [Nature 8.5 misleading](#)
- [The 1000 GtC coal question: Are cases of vastly expanded future coal combustion still plausible?](#)
- [Stats NZ - sea level rise](#)
- [Judith Curry The IPCC & Coal](#)
- [On RCP8.5 and "the Business as Usual" Scenario - Different beasts not to be confused](#)
- [NZCPS 2010 guidance notes](#)
- [Justin Ritchie presentation on youtube](#)
- [Planning for Climate Change Effects on Coastal Margins](#) 2001

Global energy-related CO2 emissions, 1990-2021

Gt CO2



<https://www.iea.org/reports/global-energy-review-2021/co2-emissions>



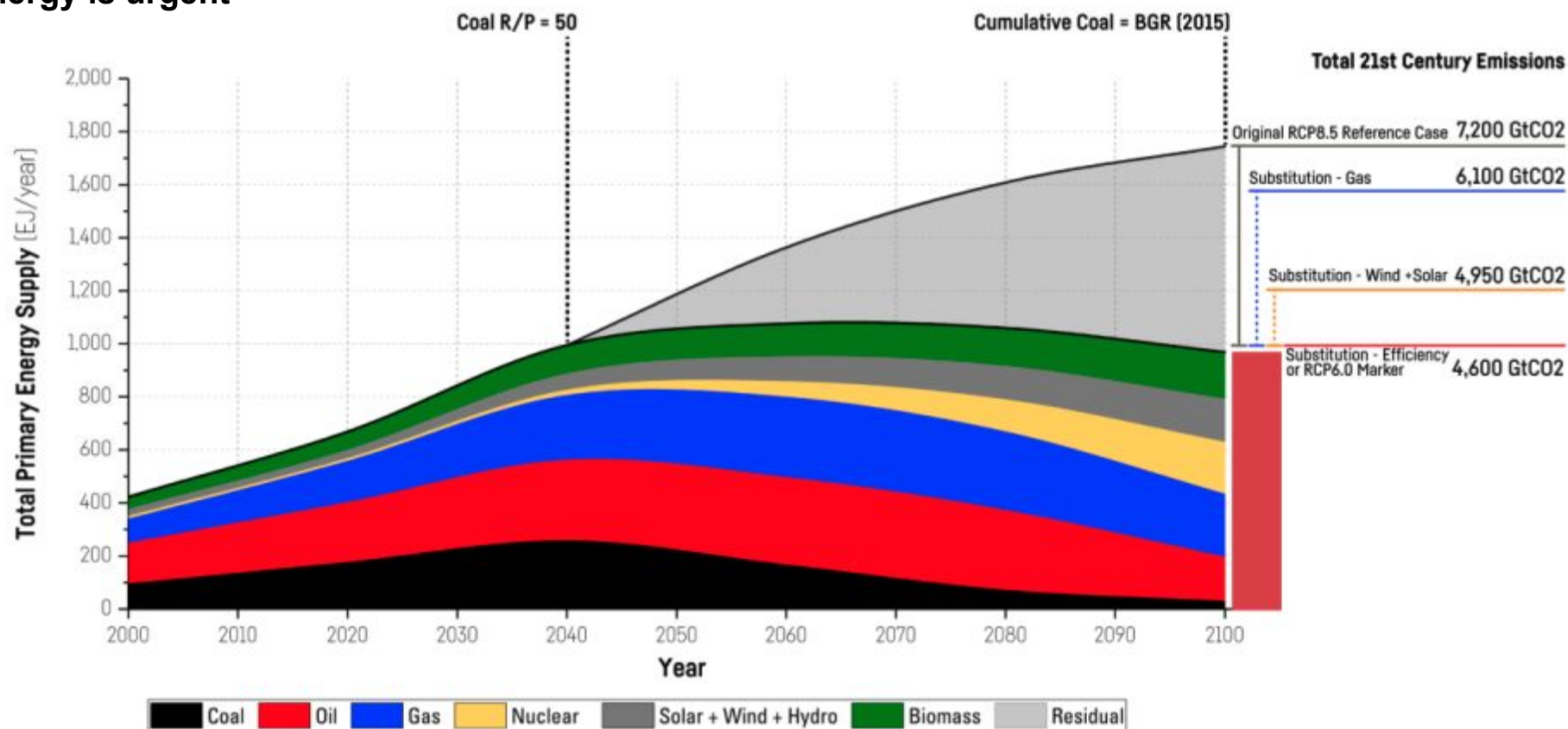
https://www.icos-cp.eu/sites/default/files/2019-12/s09_FossilFuel_and_Cement_emissions_1959.png

**We need a consistent basis
on which to assess 'high'
hazard and prevent
development.**



<http://juliansrockandiceblog.blogspot.com/2017/07/volcano-city.html>

We can't rely on coal even if it wanted to, developing renewable energy is urgent



<https://www.sciencedirect.com/science/article/pii/S0140988317301226?via%3DiHub>

Justin Ritchie and Hadi Dowlatabadi

Accessible coal reserve estimates are falling

Justin Ritchie and Hadi
Dowlatabadi

Institute for Resources,
Environment and
Sustainability, University
of British Columbia

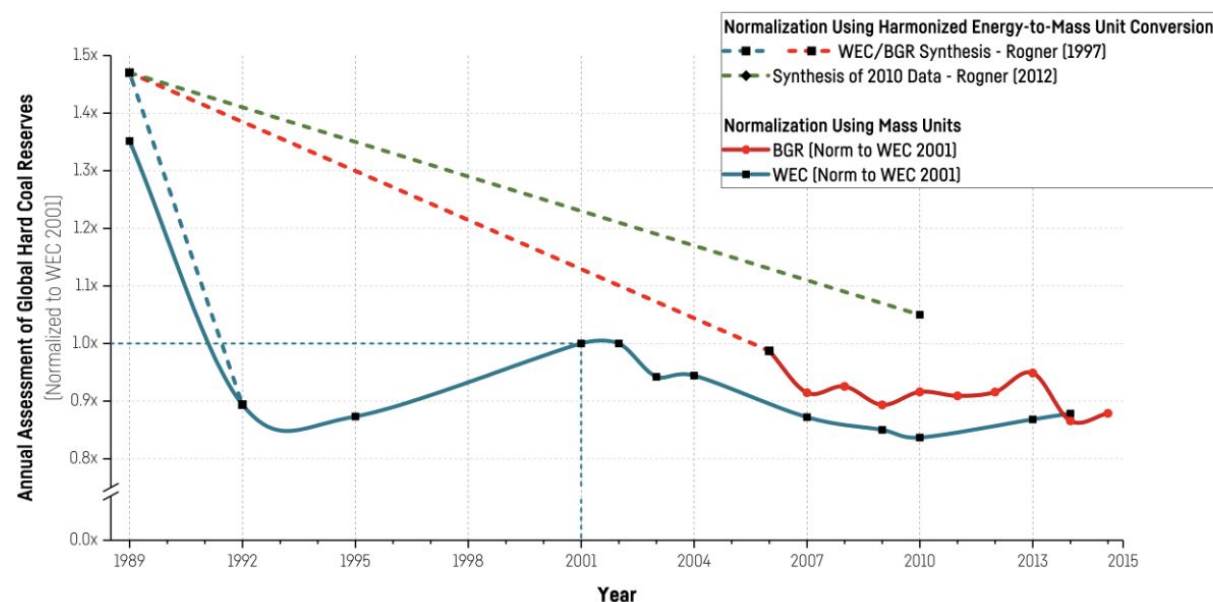


Fig. 1c Coal reserves in mass units from successive WEC and BGR reports indexed to WEC (2001). The WEC-BGR synthesis reported by Rogner (1997), and the updated Rogner et al. (2012) normalized to WEC (2001) using harmonized energy-to-mass units; note y-axis break

<https://www.sciencedirect.com/science/article/pii/S0140988317301226?via%3Dihub>

Coal production is leveling off

Justin Ritchie^{1*} and Hadi
Dowlatabadi¹

Institute for Resources,
Environment and
Sustainability, University
of British Columbia

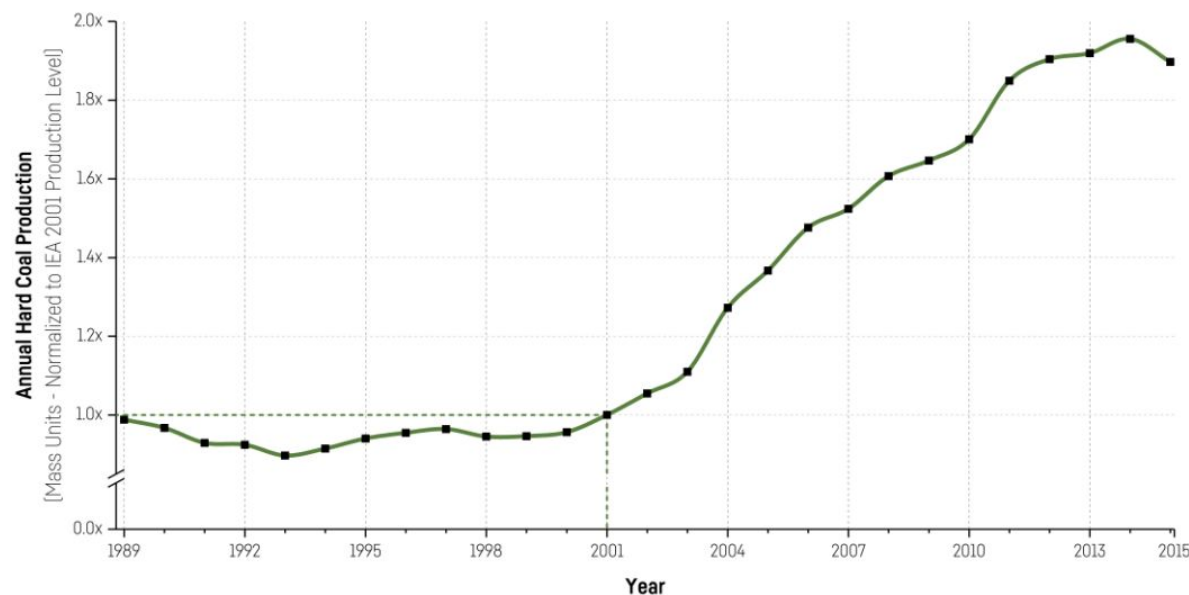


Fig. 1b Annual hard coal production as reported by IEA Coal Information Reports, WEC and BGR (indexed to IEA reported values for 2001 in mass units); note y-axis break

<https://www.sciencedirect.com/science/article/pii/S0140988317301226?via%3Dihub>

In the IPCC's business-as-usual scenario, Representative Concentration Pathway (RCP) 8.5, coal accounts for half of future carbon-dioxide emissions through 2100, and two-thirds of the emissions through 2500.

The IPCC's coal burn is enormous, twice the world reserves by 2100, and seven times reserves by 2500.

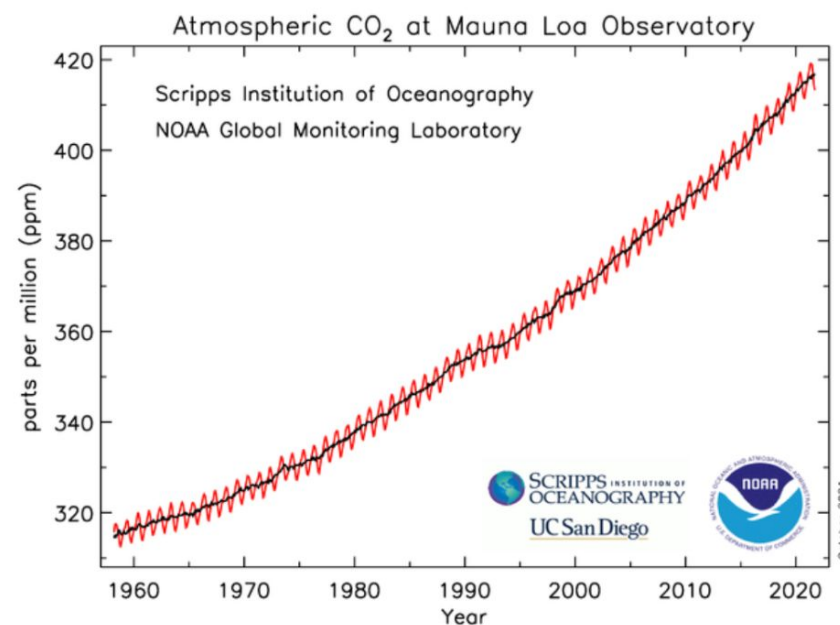
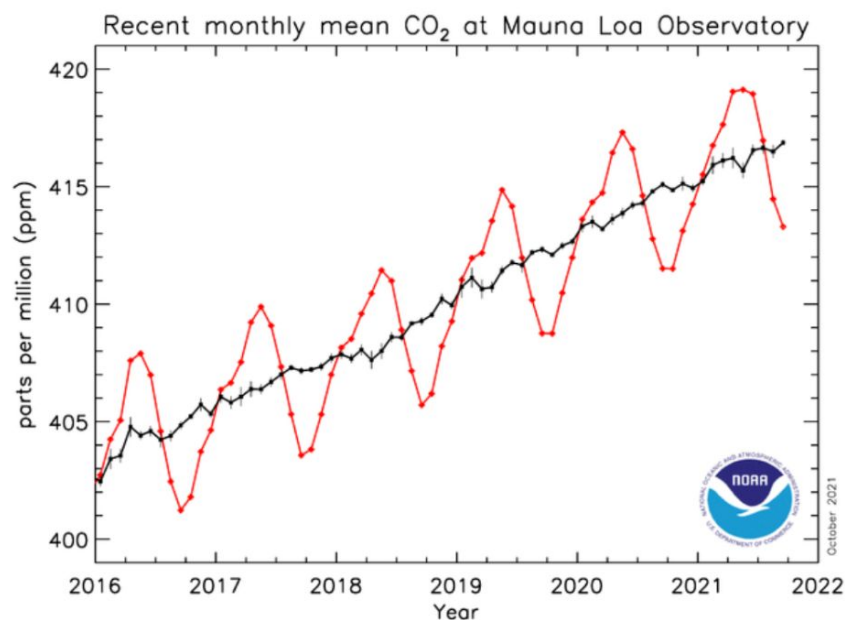
<https://judithcurry.com/2014/04/22/coal-and-the-ipcc/>

Monthly Average Mauna Loa CO₂

September 2021: 413.30 ppm

September 2020: 411.52 ppm

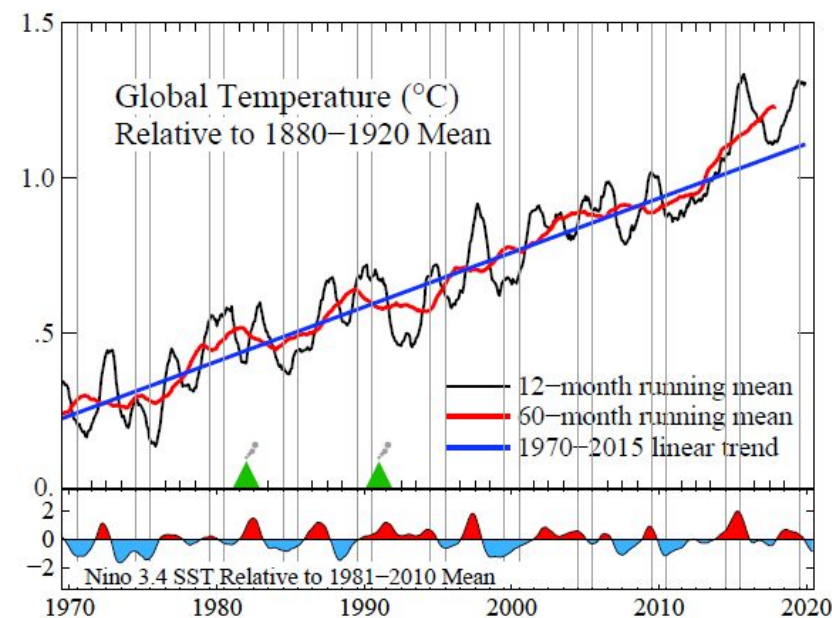
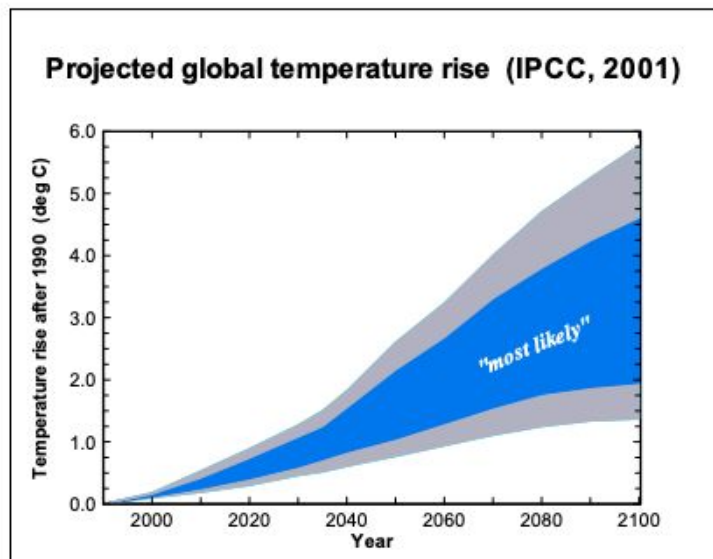
Last updated: October 5, 2021



<https://gml.noaa.gov/ccgg/trends/>

the IEA 2020 World Energy Outlook 'stated policy' scenario (International Energy Agency, 2020), project approximately constant fossil and industrial CO2 emissions out to 2070, approximately in line with the medium RCP4.5, RCP6.0 and SSP2- 4.5 scenarios (Hausfather and Peters, 2020b)

Figure 7: IPCC (2001a) climate model projections up to 2100 for: (UPPER) global mean air temperature rise, and (LOWER) global mean sea-level rise, both relative to 1990 levels. The "most-likely" zone shows the range of the average of seven ocean-climate model simulations for each of 35 socio-economic/ emission scenarios. The adjacent medium-shaded regions show the range of all seven models for all 35 scenarios. The outer light-shaded zones for sea level show the range of all models and scenarios including uncertainty in land-ice changes,



<https://environment.govt.nz/assets/Publications/Files/effect-coastal-sep01.pdf>

<https://www.co2.earth/global-warming-update>

Submission on Proposed District Plan Changes (Coastal Hazards).



1. Interpretation of Coastal Policy Statement
2. Timing
3. Tsunamis

Simon Watts
The Brighton Observatory of Environment and
Economics (BOEE)

The Brighton Observatory of Environment and Economics

Interpretation of Coastal Policy Statement



Inclusion of Tsunamis in DP: proposal not consistent with treatment of earthquakes, which are strongly linked and analogous.
(polite) Wrong headed to include them, like opening Pandora's Box

The Plan change needs to happen: giving effect to (positively implement) the NZCPS is a necessary first step in adaptation.

“...**avoid** redevelopment, or change in land use, that would increase the risk of adverse effects from coastal hazards...”

“avoid” What does this mean in planning terms (planners are the sharp end)

refs if applicable

The Brighton Observatory of Environment and Economics

NZCPS Policy 25(b) "Avoid"



"avoid"

- Risk to Property (not persons: previous CCC Planning response included/focused on persons). This distorts policy implementation and gives perverse outcomes.
- "avoid" in previous response did not give "lower overall risks" to property
- The definition of "avoid" to mean "prevent" hinges on the caveat in the King Salmon ruling that "avoidance" does not necessarily mean that all effects regardless of scale and time must be avoided
- RMA amendment which refers (6h) to the *"management of significant risks from natural hazards"*. This amendment post-dates the NZCPS and the *King Salmon* case, and therefore must add context to an interpretation of the degree of risk which is to be avoided.

Atkins, Majurey and Dawson () The King Salmon Decision (Supreme Court in *Environmental Defence Society Inc v New Zealand King Salmon Company Limited* [2014] NZSC 38) – a think piece for planners. New Zealand Planning Institute (NZPI).

The Brighton Observatory of Environment and Economics

Timing



We appreciate that the District Plan does not currently give effect to the NZCPS, (as required by the RMA). This is because an independent hearing panel (IHP) of The Environment Court Decision #53 (effectively) agreed that the basis of the hazards being “avoided” was not robust. That is the present and we need to move forward.

But why during the largest overhaul of RMA for 30 years being implemented? New system operative in 3-5 years time. Then DPs unlikely to exist in the way we currently understand them. Is 5 years too long to wait?

Unlike other planning processes we know or are familiar with, we are often working at ranges of a century plus (three generations hence), under conditions of extreme uncertainty. (Joint Community-Council agreed Trigger points will be required).

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The Brighton Observatory of Environment and Economics

Timing



The then Parliamentary Commissioner for the Environment, Jan Wright put it well when she said (of adaptation):

"...We have time to do this well..."

In this context "well" could and should include decreasing inequity, increasing community well-being, leaving no-one behind, building a better more sustainable world for our children...etc.

XXXX

The Brighton Observatory of Environment and Economics

Submission on Proposed Coastal Adaptation Framework



Role of Council Representation

- of other relevant parties in process (not just Council)
- of coastal residents in Coastal Panel

Timing

The Brighton Observatory of Environment and Economics

Role of Council



Private Infrastructure

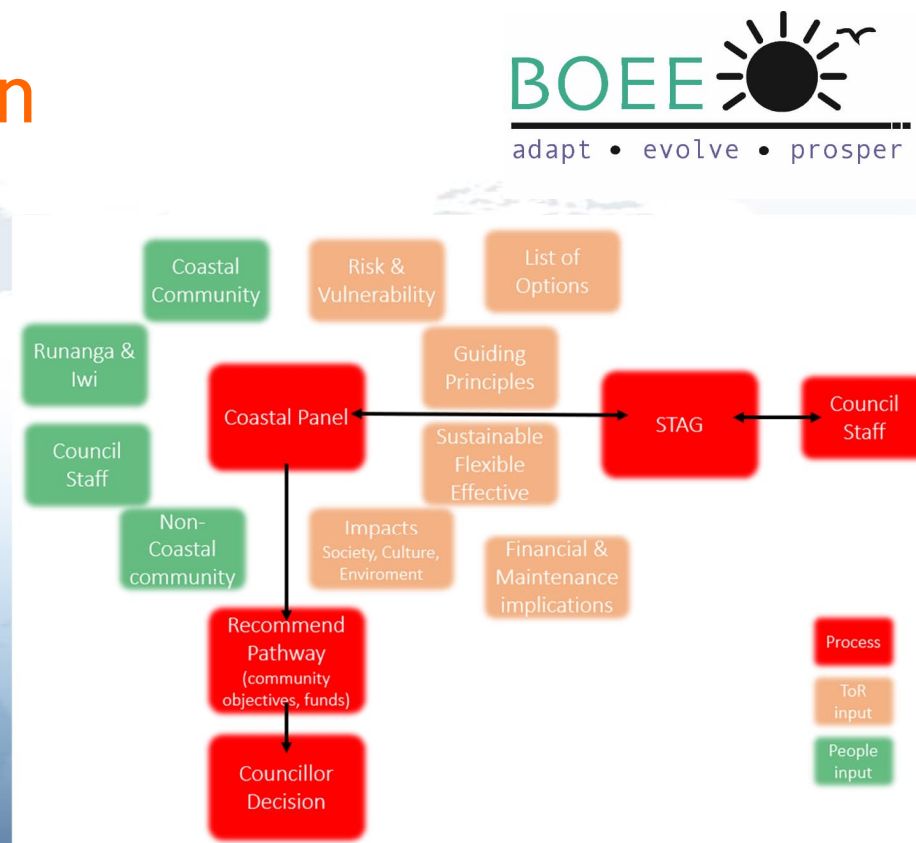
1. LGNZ legal opinions differ with the assertion that Council is not responsible for private assets in a situation that is not due to the council's or residents' foolishness or omission
2. The Local Government Act affirms that Council has responsibilities for the well-being of its residents
3. This is a national problem and Christchurch is only one part
4. Council is our local government agency, and government has signed international accords which are directly relevant:
 - Sendai Framework of Disaster Management
 - The Sustainable Development Goals

Climate Change litigation – Who's afraid of creative judges?. <https://www.lgnz.co.nz/our-work/publications/climate-change-litigation-whos-afraid-of-creative-judges/>
The Brighton Observatory of Environment and Economics

Representation

Of coastal residents in Coastal Panel

- Ownership of decision by local communities (30%)
- Different places have different risk appetites, real risk that the types of decision by panels will be homogenous
- No mention in the process of trigger points, or the way community will be party to their development.



XXXX

The Brighton Observatory of Environment and Economics

Representation



Of other relevant parties in the process

- The Council needs not to be the only party 'on the other side' of the table, e.g. MOH, CDHB
- It may be that MfE staff could be part of the STAG, or sit on a Council committee in an observer/advisory role
- ?

XXXX

The Brighton Observatory of Environment and Economics

Questions



.....Judge a person by their questions, not their answers... (Blais Pascal)

The Brighton Observatory of Environment and Economics

Coastal Hazards Working Group Conversations

Hearing of submissions 04/02/2022

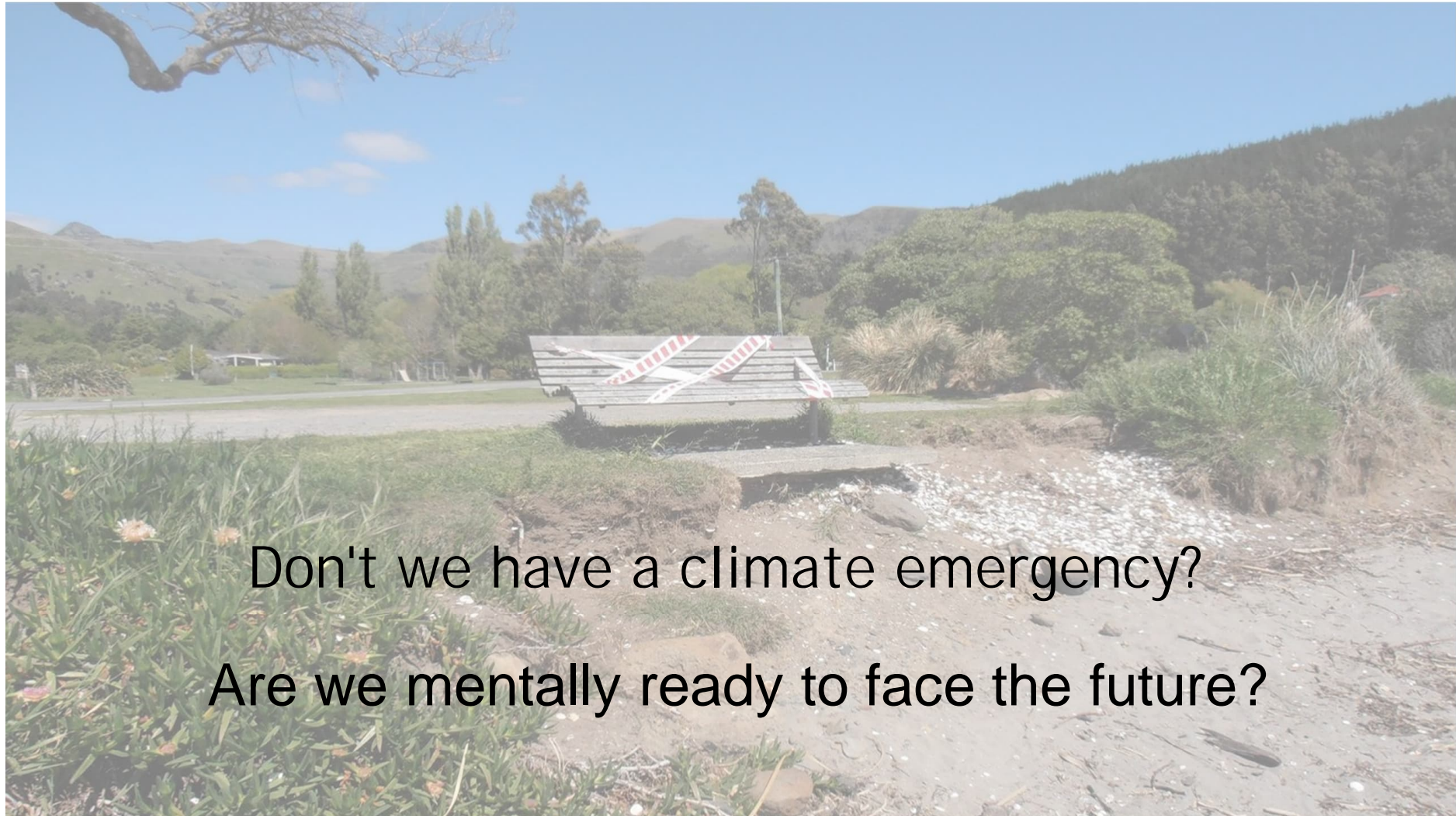
Thomas Kulpe



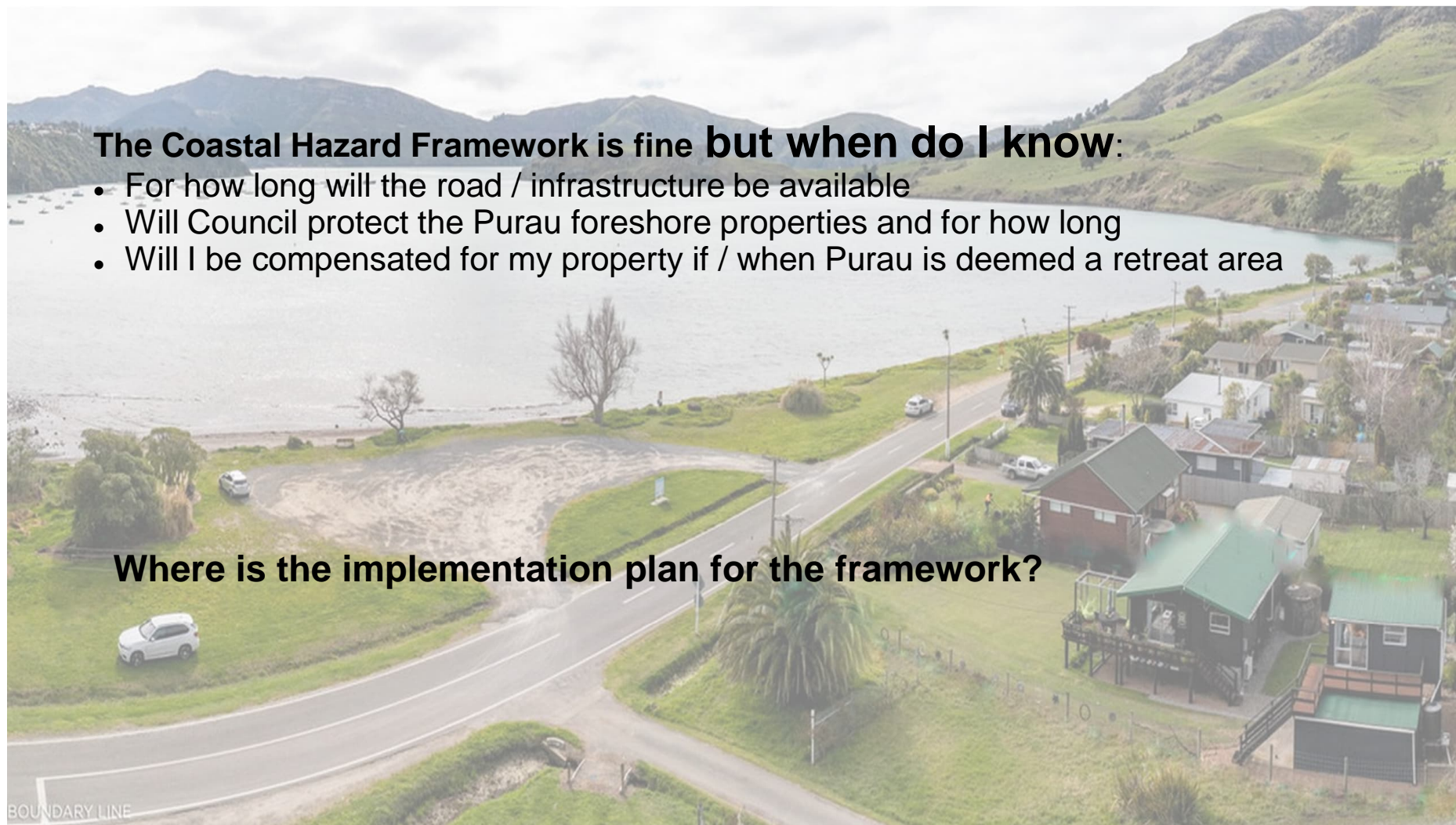
One picture is worth a thousand words

Images used in the coastal hazard brochures are exclusively of
serene and idyllic nature





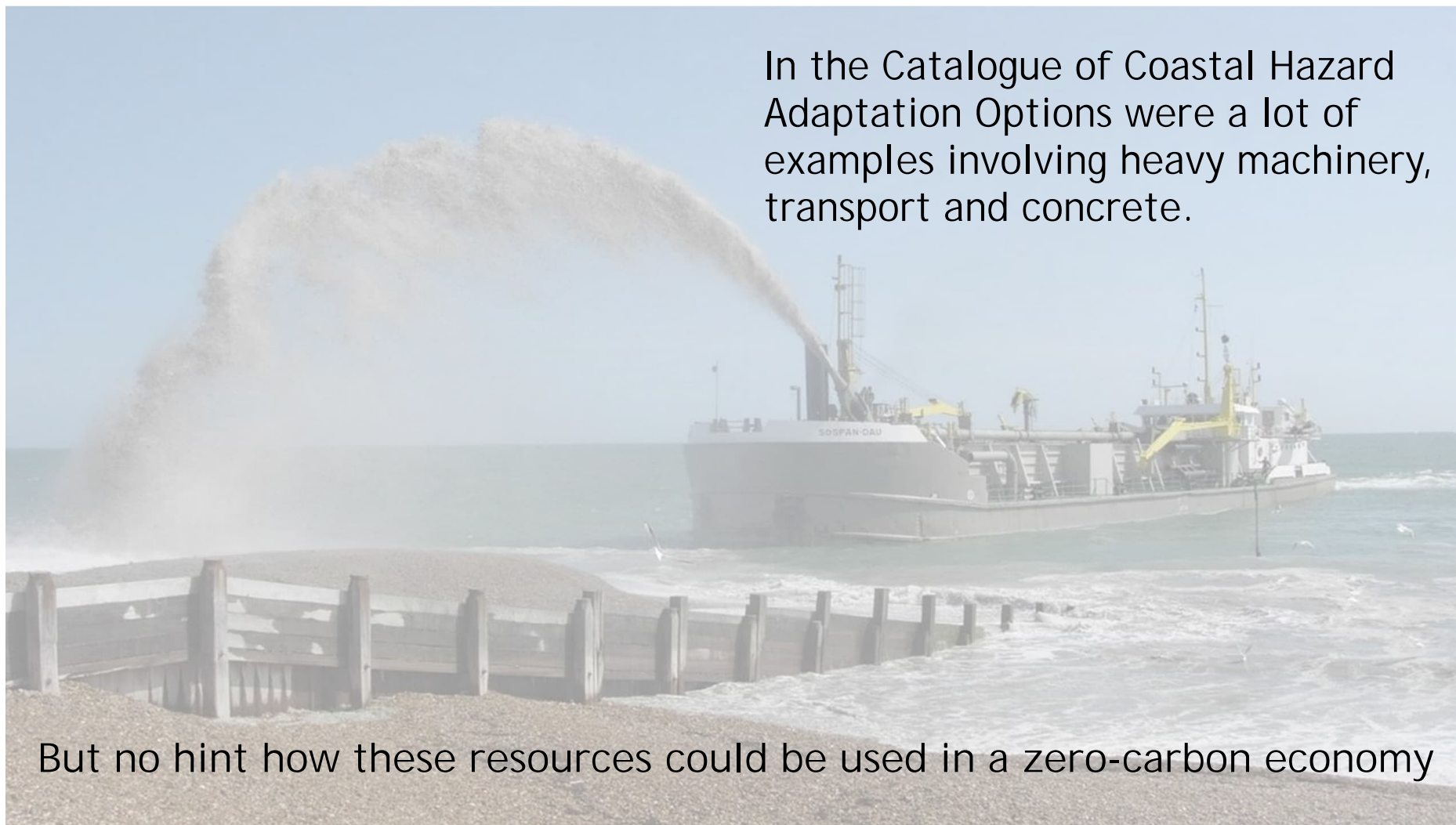
Don't we have a climate emergency?
Are we mentally ready to face the future?



The Coastal Hazard Framework is fine but when do I know:

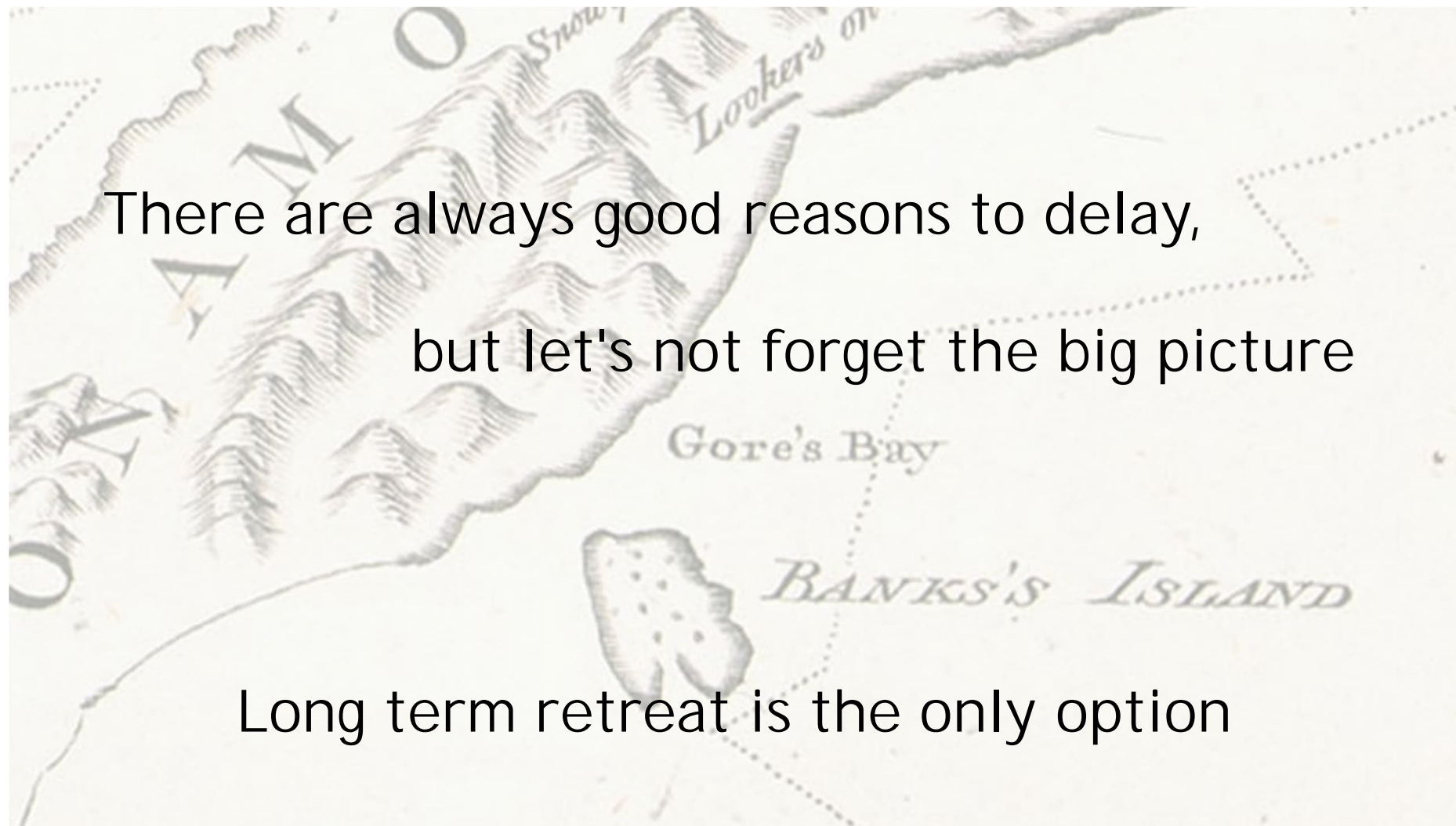
- For how long will the road / infrastructure be available
- Will Council protect the Purau foreshore properties and for how long
- Will I be compensated for my property if / when Purau is deemed a retreat area

Where is the implementation plan for the framework?



In the Catalogue of Coastal Hazard Adaptation Options were a lot of examples involving heavy machinery, transport and concrete.

But no hint how these resources could be used in a zero-carbon economy



There are always good reasons to delay,
but let's not forget the big picture

Long term retreat is the only option



Work on the Seawall

Presentation to Coastal Hazards Working Group Feb 4 2022 by Brian Sandle

I like Jo Zervos idea that everything is intertwined. My submission asks to extend the environment care concept of evacuated areas to areas where evacuants may move to. What may we look forward to? Coastal hazards are one aspect of climate change and ECAN thinks another aspect may be more drought in Canterbury.

It is very important to me for our city to be able to retain activities like walking and gardening, which I feel may be under threat from urban densification to accommodate people displaced by coastal hazards.

By 2015 Sport and Recreation NZ said gardening surveyed at 44.5% of adults. Walking was at 60%. Whereas in 2003 gardening had been 60% and walking 72%. Result of choice, or rather of urban densification?

I am fortunate to live over the road from the New Brighton dunes and quite a lot of people walk past and some may stop and talk to me if I am working out the front. Sometimes we talk about the reservoir of sand in the dunes protecting

properties from big storms and tsunamis. People may not get that opportunity of healthy social interaction in apartment living, when there may be minimal close-by associated gardening space for being active and relaxed.

So I ask for this Working Group to petition for our Regional Plan to allow a small proportion of our rural land near Christchurch to be subdivided down to 0.2 hectare sections. Half of each section should be required to be developed into indigenous vegetation and the remainder be required to be mainly garden area without excessive house size. The details can be discussed. The resulting biodiversity stewardship could provide much needed activity as the coming robots take over driving and many types of employment from humans. People who take this resettlement option up may need a training and/or supervision.

I may be labelled as promoting urban sprawl. But my plan is the opposite of what happened with in-fill housing of the Burwood market gardens. It is to make it affordable, for those who wish, to be able to take part in increasing actual green space and biodiversity per hectare around our city's outskirts and to encourage that.

The early work of the Selwyn Plantation Board to stop Canterbury soil being blown out to sea has been undone by the dairy industry. Irrigation has held the soil, but increased drought in Canterbury may make irrigation more difficult. We should start early putting in trees again for shelter from sun and drying wind. Planned properly it may even help to reduce some CO₂/ methane emissions

By using existing rural roads my plan should minimise take of shingle from Waimakariri river. Then build up of sand on Pegasus Bay beaches may be able continue to beat sea level rise, though it had been interrupted somewhat by the quakes.

Please be ready for houses to be covered in new technology solar panels. And using new technology storage batteries like the sodium ion battery in the house, power for vehicles should not be such a problem. Cellphone-computer-coordinated ride sharing should help with flexibility of travel destinations and hours. That may need co-ordination help from councils.

New technology sewage treatment can provide energy as well as save water for bush irrigation. Carefully planned shade from bush, from house or maybe from

some adjustable solar panels and expert mulching may minimise water loss. So the cost of water reticulation may be avoided. Even if there does happen to be water available to pump. Better agriculture may help make up for any land lost to sea level rise.

Finishing, some thoughts from “Greening the Desert.” by Dr Mae-Wan Ho.
“For years, many scientists have been making dire predictions of widespread irreversible ‘desertification’ in the African Sahel.

But satellite images consistently show an increase in greenness.

There are areas in which the vegetation has been greening more than explained by rainfall or irrigation alone and human factors are involved

Their techniques of local knowledge might be experimented with here as insurance here in this time of climate uncertainty.

<https://www.i-sis.org.uk/greeningTheDesert.php>

Thanks for being able to hear me.

Avon Heathcote Estuary Ihutai Trust Board's Submission

On the Coastal Hazards Adaptation Framework - December 2021

Presentation to the Christchurch City Council Working Group February 2022

My name is Ann Kennedy and I am representing Kit Doudney, the Chair of the Avon Heathcote Estuary Ihutai Trust Board.

Introduction

We value the ecological components and the ecosystem services of the Estuary. The species, habitats and ecosystems are very vulnerable at present, and with climate change, without due diligence to planning, they will continue to be vulnerable. Vulnerable species, habitats and ecosystems must be managed in ways that support their resilience and sustainability. Healthy ecosystems are vital to the Estuary; and yet they remain under threat.

We are aware of the challenges of the adaptive capacity ahead of us.

From our Adaptation Framework Submission you will see that we agreed -

- That the proposed planning involves communities, Rūnanga and Council working together for the best possible sustainable outcomes.
- The proposed planning involves research on options and adaptation pathways for addressing hazards.
- The staggered approach is best.
- The main risks are coastal flooding, erosion and rising groundwater.

From those four points I wish to discuss the two requests we made in our Submission in December last year.

1. The development of a climate change management plan for the estuary
2. That the Avon Heathcote Estuary Ihutai Trust Board be identified as a significant stakeholder and have a place on the Adaptation Area community team.

Purpose of a Climate Change Plan

1. Estuary Landscape and Energy

The Estuary shoreline is made up of silty sand, fine sand, shell or mixed sand and gravel on the upper beach with a wide intertidal zone and no dune system. Due to this variation between the composition of the upper beach and the intertidal flats, the estuary is expected to behave differently to sandy beaches in response to a rise in mean sea level.

While estuaries tend to be areas of sediment deposition, it is expected that future sea level rise will be greater than the rate of sedimentation and therefore there will be an increase in water depth across the estuary. The greater water depth will allow greater wave heights to act on the shoreline, increasing the erosion potential. However, as it is a low energy environment, erosion is likely to occur more episodically and more slowly than the open coast environment.

2. Sea level rise and Landward Migration of Plant Communities

As sea levels rise vegetation communities are expected to migrate landward to maintain their position relative to the water level. If the rates of sea level rise are accelerated, some vegetation communities may not be able to survive. For those which do, it will take time for them to adjust.

Plant communities, habitats and feeding grounds will only be able to migrate where there is adequate space available and conditions suitable. Modifications, such as roads, seawalls, cycle tracks will block migration. Available and suitable areas must be found and set aside for the purpose of migration.

3. Ecology and Aquatic Species Migration

The key ecological effects of a 1.0m rise in mean sea level on the ecology are:

- Eelgrass, sea rush and salt marsh species will be squeezed out as the intertidal zone reduces in area
- Fish species expected to move with the transition in salinity. Eventually some species such as flounder, eels, and inanga will lose their feeding grounds as water depths progressively increase
- Wading birds will also be affected by a loss of habitat.

In areas where there is space for migration, there will be a progressive die off of non-salt tolerant species with the rise in water levels and a succession to more salt tolerant species with the same vertical zonation as currently present.

4. Planning Responses

The planning response for the estuary ecology could mimic that put forward by Tonkin and Taylor 2013, where it is stated that the impacts from sea level rise on existing development can be reduced through managed retreat.

Managed retreat as a planning response for the Estuary means a strategic decision to extend the estuary area and provide aquatic and terrestrial habitat in a new landward position.

5. Drought

During dry seasons and drought conditions river and stream inputs can be expected to reduce. Recharge of the aquifers will be reduced also causing ground water to lower. Surface run-off and stormwater will also reduce or be non-existent.

Based on national assessments of drought under climate change, droughts are likely to become more frequent and sever in regions that are currently drought prone, notably eastern parts of Canterbury.

The five points above:

- Landscape and Energy
- Landward migration
- Ecology and Species Migration
- Planning Response of managed retreat
- Drought

will be the main topics of research for the Proposed Plan.

Looking at Our Planning Documents -

Otautahi Climate Change Resilience Strategy 2021 –

Goals 2 and 4 state:

2. *We understand and are preparing for the ongoing impacts of climate change*
6. *We are guardians of our natural environment and taonga.*

Signs of success – what we want to see

- *Support our kaitiaki – we'll support people and groups who are kaitiaki (caretakers) of our environment and taonga.*
- *Value nature – our community will understand, value and care for our indigenous plants, animals and ecosystems.*
- *Restore ecosystems – vulnerable species, habitats and ecosystems will be protected and managed in ways that support their restoration.*
- *Garden city – green spaces and healthy ecosystems will be protected as a vital part of our district.*
- *Natural carbon absorption – carbon dioxide will be removed from the atmosphere in ways that benefit local ecosystems and communities.*

Next step for Council: To complete Christchurch's climate change risk assessment, including environmental, social, cultural and economic impacts.

Our climate change goals for Christchurch Our goals set out what we want to achieve to limit the impacts of climate change. While they focus on four specific areas, there are many links between the goals, and some of the actions we take will provide mutual benefits across multiple areas. For example, planting native trees and restoring wetlands is an action that will contribute towards achieving each of the goals. Trees and wetlands absorb carbon dioxide emissions (Goal 1), provide flood mitigation to protect from future storms (Goal 2), provide local jobs (Goal 3), and restore the natural environment (Goal 4)

Coastal Adaptation Framework

Keep managed retreat on the table

We will consider all options for managing the risks posed by coastal hazards for communities, including managed retreat. This is in line with the New Zealand Coastal Policy Statement 2010. While managed retreat is a challenging adaptation option in terms of implementation, and social and economic impacts, it offers a long-term sustainable option that can remove the risk of coastal hazards, allowing natural coastal processes to unfold. It can also be used to create natural protection buffers for other at-risk assets. (This is applicable to the Estuary).

With regard to the Estuary's greater risks and vulnerabilities developing from climate change, we request that an Estuary Environmental Management Plan (Avon Heathcote Estuary Ihutai Climate Change Plan) be included in the Coastal Adaptation Framework.

We also request that the Trust Board of the Avon Heathcote Estuary Ihutai be recognised as a major stakeholder and be included in the Area Planning.

Thankyou