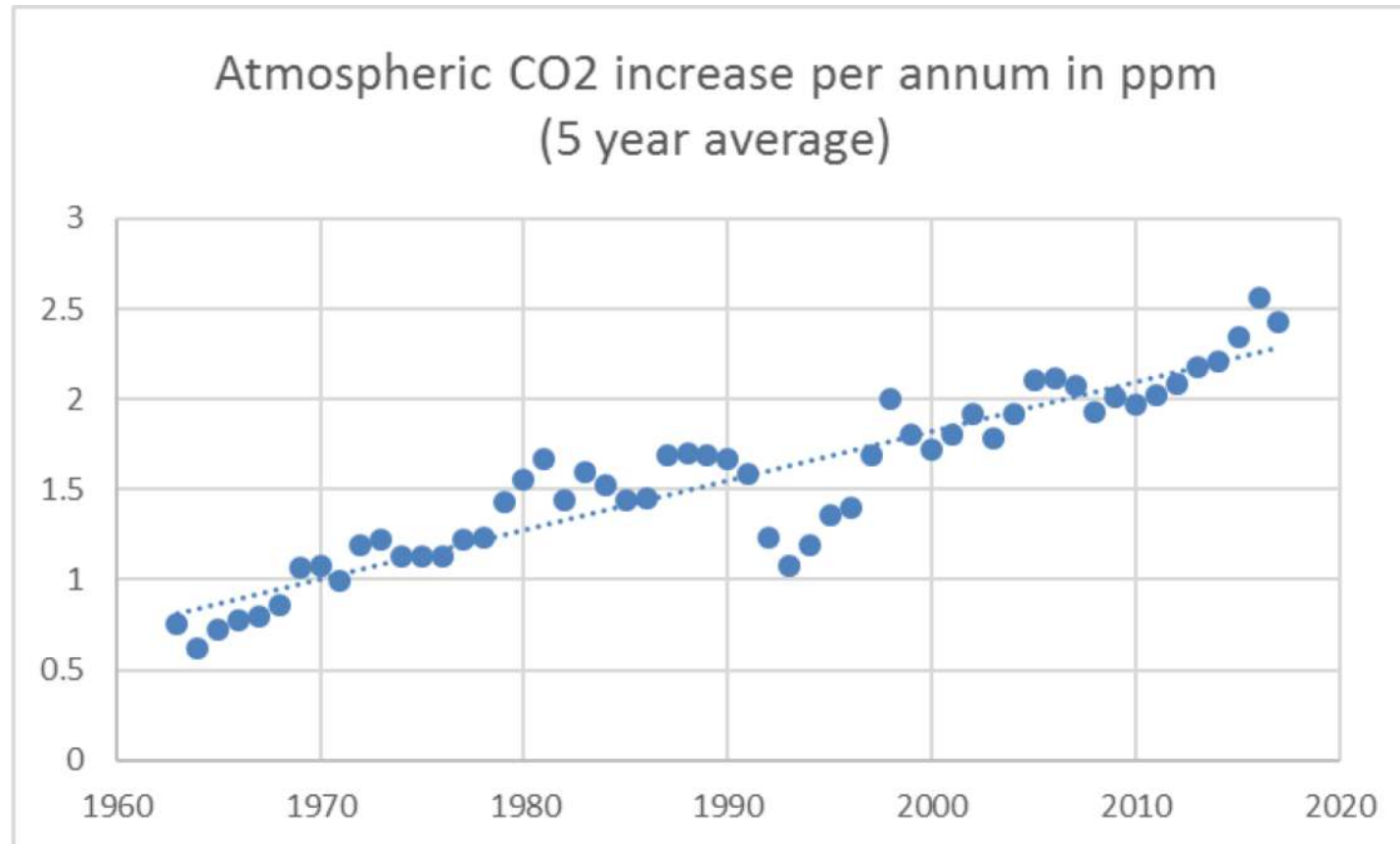


Climate Change - Tell the truth



First a recap: CO₂ in atmosphere is increasing at an increasing rate: now 410ppm*

*NOAA August 2019 409.95 ppm



October 2018

The IPCC 1.5 paper



Chapter 2: Mitigation pathways compatible with 1.5°C in the context of sustainable development

Table 2.2: The assessed remaining carbon budget and its uncertainties. Shaded grey horizontal bands illustrate the uncertainty in historical temperature increase from the 1850-1900 base period until the 2006-2015 period, which impacts the additional warming until a specific temperature limit like 1.5°C or 2°C relative to the 1850-1900 period.

Additional warming since 2006-2015 [°C]*(1)	Approximate warming since 1850-1900 [°C]*(1)	Remaining carbon budget (excluding additional Earth-system feedbacks*(5)) [GtCO ₂ from 1.1.2018]*(2)			Key uncertainties and variations*(4)					
		Percentiles of TCRE*(3)			Additional Earth-system feedbacks*(5)	Non-CO ₂ scenario variation*(6)	Non-CO ₂ forcing and response uncertainty	TCRE distribution uncertainty*(7)	Historical temperature uncertainty*(1)	Recent emissions uncertainty*(8)
		33 rd	50 th	67 th						
0.3		290	160	80	Budgets on the left are reduced by about 100 GtCO ₂ . If evaluated to 2100 and potentially more on centennial time scales	+250	-400 to +200	+100 to +200	+250	+20
0.4		530	350	230						
0.5		770	530	380						
0.6		1010	710	530						
0.63	~1.5°C	1080	770	570						
0.7		1240	900	680						
0.8		1480	1080	830						
0.9		1720	1260	980						
1		1960	1450	1130						
1.1		2200	1630	1280						
1.13	~2.°C	2270	1690	1320						
1.2		2440	1820	1430						

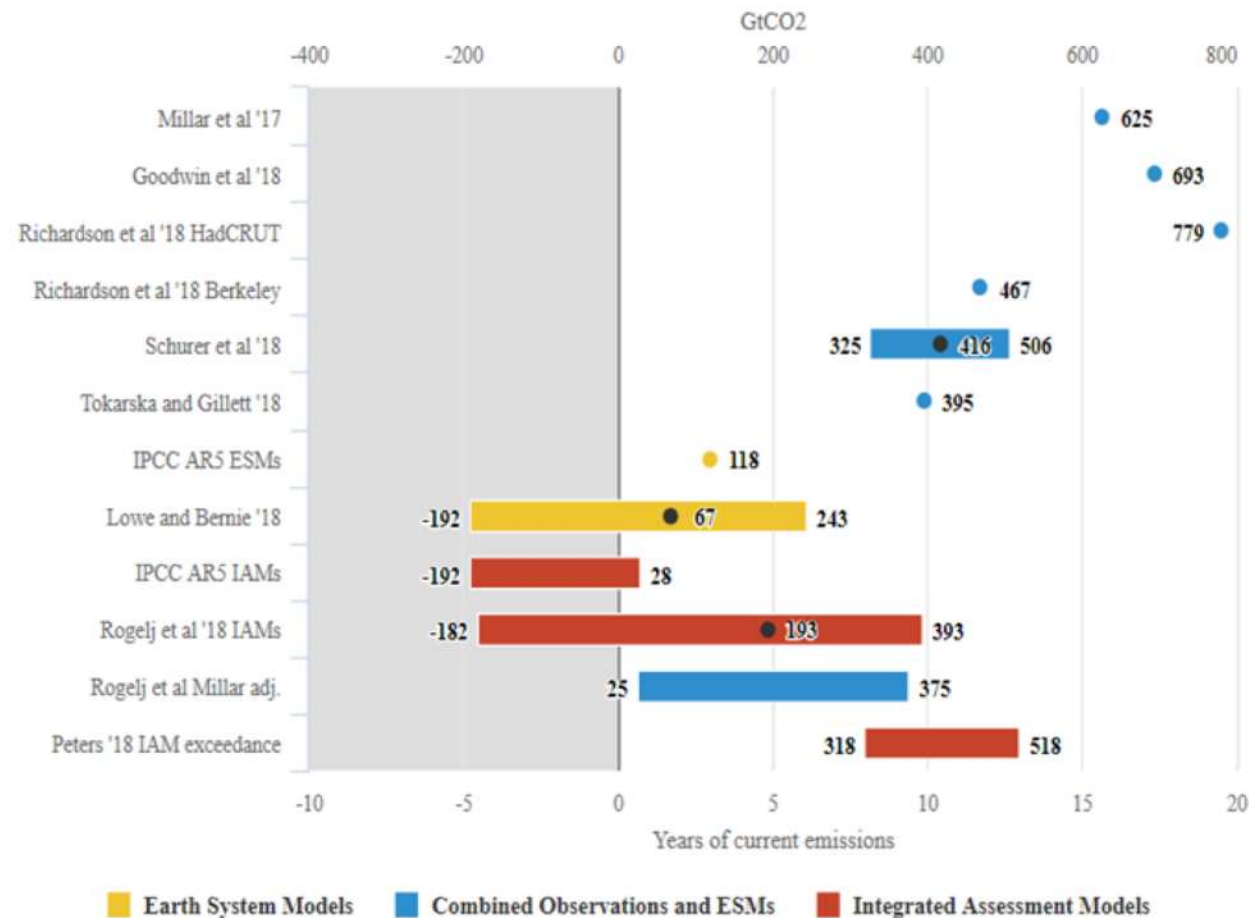
Table 2.2 Chapter 2 1.5 Report

Amounts in Giga Tonnes CO2 from 2018

	???	Success probability	
☞ Temperature			
☞ Increase since			
☞ ≈1870	33%	50%	66%
☞ ~1.5°C	1080	770	570
☞ But with various caveats and uncertainties: subtract 100 Gt for feedback to 2100. Non CO2 forcing -250 Gt. This gives a budget of 220 Gt (OR 5 years BAU from 2018)			
☞ The above result was obtained from MODELLING			
☞ The other way of predicting temperature rise is from PALEO SCIENCE (ie what happened to the earth in the past)			
☞ The paleo science generally predicts more severe effects than the modelling Steffen et al paper (Hothouse Earth) and suggests larger uncertainties.			

Carbon Brief C Budget estimates for <1.5 degrees from 2018 (Modelling)

Remaining carbon budget for a 66% chance of less than 1.5C warming

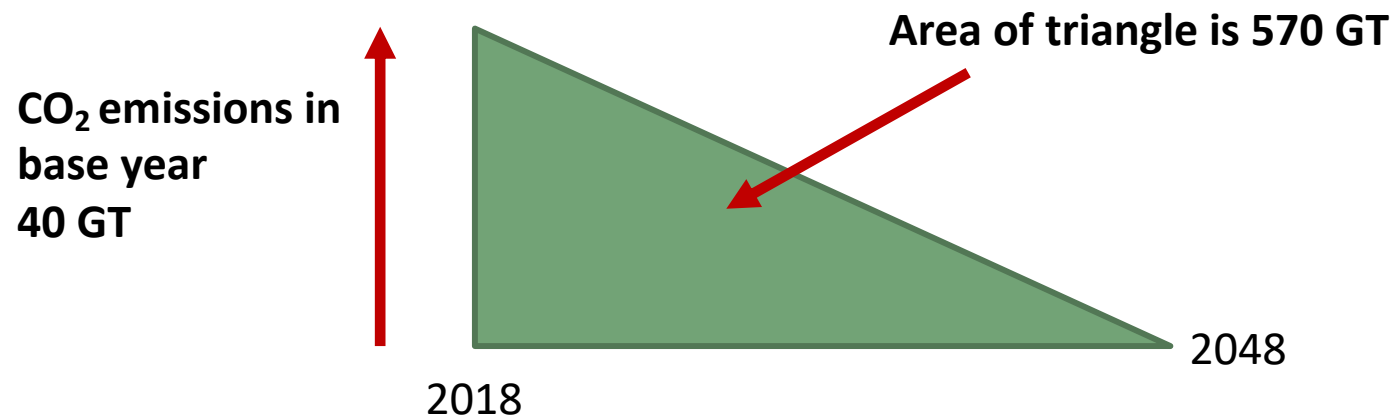


IPCC 1.5 degrees: from 2018:

Thus for 66% chance of saving world we have around 600Gt from 2018 (ie the high end of our earlier estimates)

If we calculate when this budget would expire we find that $\text{Years} = (570) \times 2 / 40$
 $= 29$ years

ie zero emissions by 2047 (IPCC 1.5 says 2050)



Paleo Science and the Hot House Earth paper

- ☞ Fisher et al “Paleoclimate constraints on the impact of 2 °C anthropogenic warming and beyond” Nature Geoscience | VOL 11 | JULY 2018 | 474–485).
- ☞ Steffen et al PNAS August 6, 2018 “Trajectories of the Earth System in the Anthropocene”
- ☞ Our analysis suggests that the Earth System may be approaching a planetary threshold that could lock in a continuing rapid pathway toward much hotter conditions—Hothouse Earth. This pathway would be propelled by strong, intrinsic, biogeophysical feedbacks difficult to influence by human actions, **a pathway that could not be reversed, steered, or substantially slowed**”.

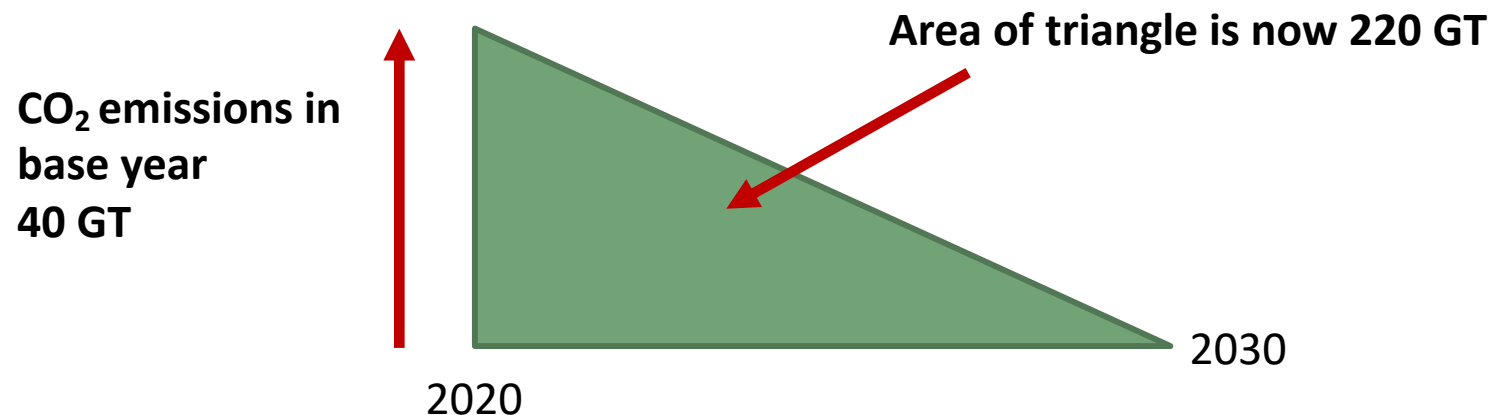
IPCC 1.5 degrees: from 2020 including other gasses and feedback :

Since 2018 we have used around 80 Gt CO₂

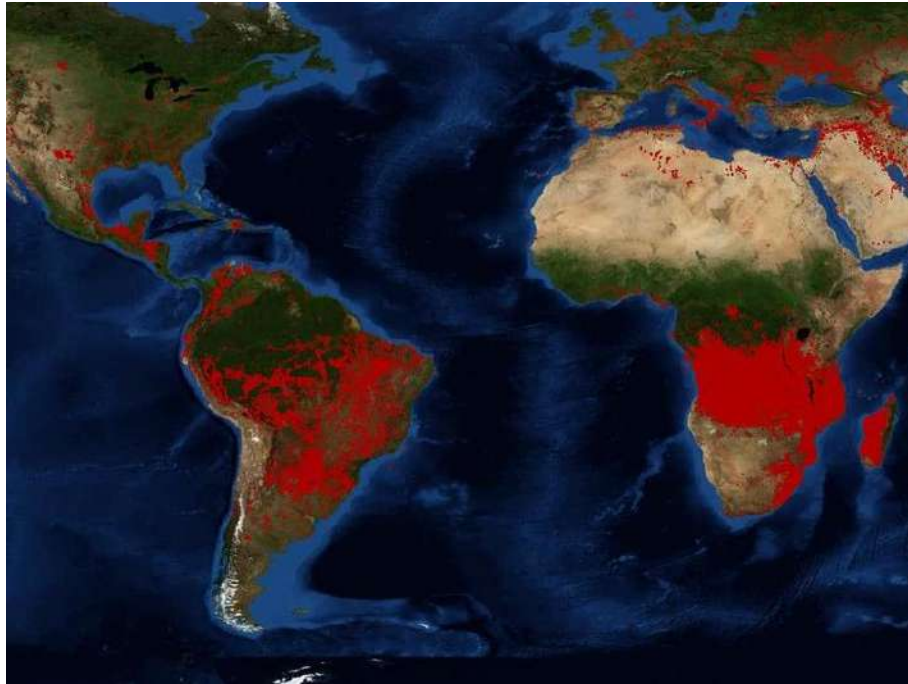
So if we do the sum again and find that $\text{Years} = (570 - 350 - 80) \times 2 / 40 = 7$ years
ie zero emissions by 2027

(Note Greta Thunberg is saying 2030: XR says 2025)

Note if we do nothing the budget will be exhausted in 3.5 years ie during 2024



But the models are underestimates: in (2019) we have more catastrophic fires, floods, cyclones and droughts

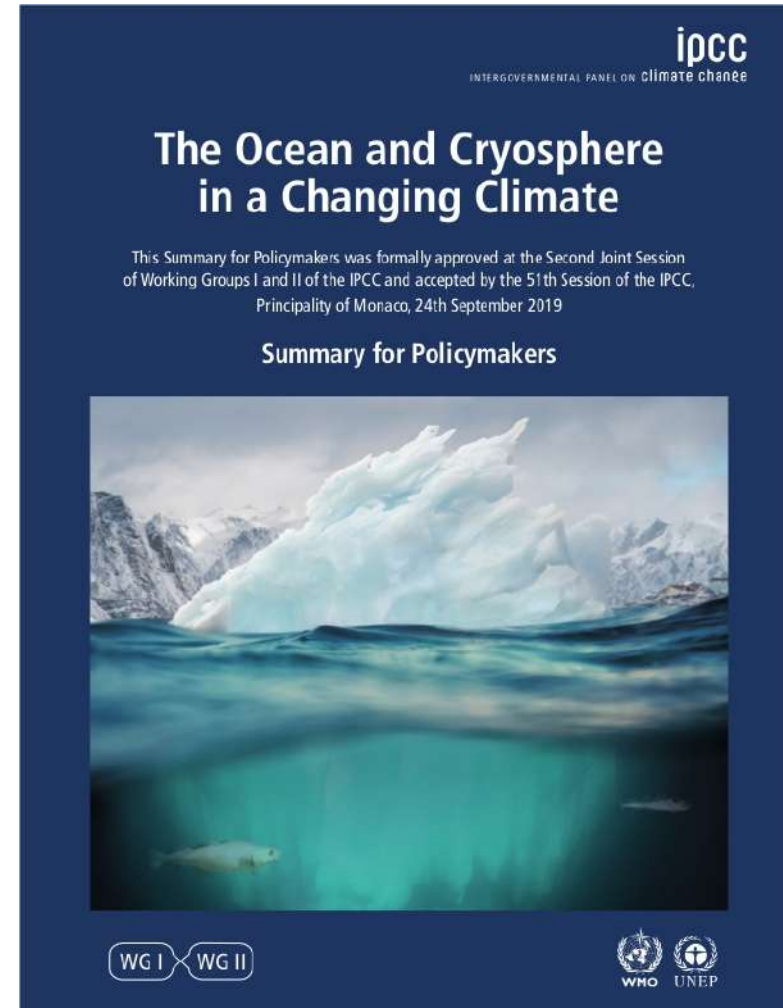
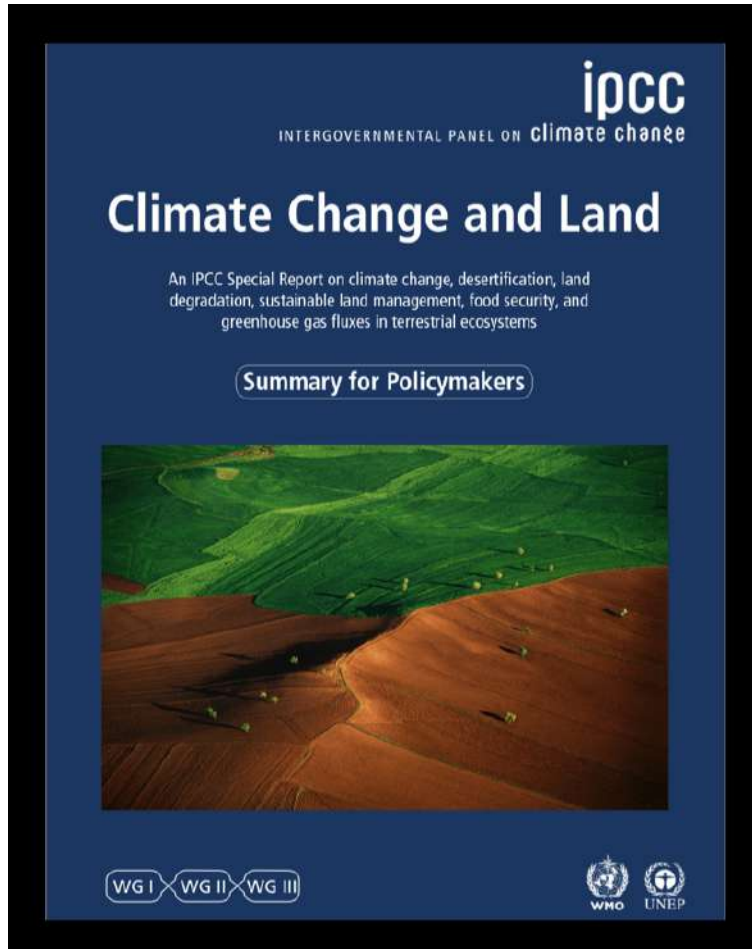


The world is on fire and there is panic in the air: August 2019



NSW – November 2019

More damming reports from IPCC 2019



So the question is?

- ☞ Why have we not acted earlier?
- ☞ Jim Hansen was saying back in 1980s that 350 ppm was the limit before feedback effects kick in.
- ☞ Malte Meinshausen (IPCC, MAGIC) gave a talk in Alexandria in 2014 saying we had already breached 2 degrees.
- ☞ The science has been pretty consistent but the voice of the scientists has been muted with a distinct fear of alarming people.
- ☞ In particular the probability limits for success have been continuously diluted: 66% in IPCC 2014, 33% appearing in IPCC 2018 1.5 report together on an increasing reliance on CCS. What engineer would build a bridge with even a 33% chance of failure let alone 66%?
- ☞ **To focus: why has the science community not acted more forcefully They have told the truth but in a way that has just not been heard – until recently?**

Then along comes Greta Thunberg:2018





extinction
rebellion

And the Extinction Rebellion (XR)




Greta Thunberg (from Naomi Klein, 2019)




- ☞ Started learning about climate change when 8 years old
- ☞ Age 11 years fell into deep depression stopped eating and speaking.
- ☞ Diagnosed with selective mutism obsessive compulsive disorder and a form of autism that used to be called Asberger's Syndrome
- ☞ Read all the scientific reports including IPCC reports
- ☞ Age 15 years (August 2018) started the school strike
- ☞ Gained attention which has since gone viral on social media
- ☞ Invited to various UN conferences, Vatican, British Parliament,, Davos (tented at - 18 °C), IPCC, Katowice Poland, and lately in the US travelling by sailing boat.
- ☞ Has gained so much attention that she is now being vilified by deniers and the conservative right.
- ☞ All in a little over one year of prominence on the world stage.

Extinction Rebellion

- ✎ Established in the UK in May 2018
- ✎ October 2018, one hundred academics signed a call to action in support
- ✎ Launched by Roger Hallam and Gail Bradbrook,
- ✎ April 2019, Extinction Rebellion occupied five prominent sites in central London.
- ✎ Three aims. 1 Tell the truth. 2, zero emissions by 2025, 3. Establish a citizen's assembly to discuss climate change
- ✎ Dramatic actions in 2019 in most countries of the world including NZ
- ✎ Hallam has said "Extinction Rebellion intends to continue civil disobedience until governments of the world declare a "climate emergency."
- ✎ Active group in Dunedin

November 2019: World Scientists' Warning of a Climate Emergency, Ripple et al, Bioscience

 **S**cientists have a moral obligation to clearly warn humanity of any catastrophic threat and to “tell it like it is.”

-  Conclusions we need major transformations in the ways our global society functions and interacts with natural ecosystems.. Changes in:
-  Energy, Short lived pollutants, Food, Ecosystems, Economy, Population
-  11,000 associated signatories including: over 200 from NZ, 35 from Otago University and 7 from my old department (physics)

So the next questions are?

- ☞ Will the Greta Effect and the Extinction Rebellion actually achieve CO2 reductions? Can the dire situation be turned around? Will the scientific community rise to the occasion?
- ☞ Both Greta and XR want rapid reduction in carbon emissions with net zero by between 2025 and 2030? This is necessary to avoid breaching tipping points without CCS.
- ☞ So I ask you the audience:
- ☞ Do you agree with the above timetable from a scientific point of view?
- ☞ Do you agree with the timetable from a political and social point of view? And what are the implications?
- ☞ In particular what will be the run on effects in:
 1. The third world
 2. The poor in the rich world
 3. The farmers and food production
 4. The economy
 5. Transport
 6. Vested Interests

Finally what are the implications of not achieving the desired CO2 reduction's?