



**DAVE LOWE**

**SCIENTIST**

**GOETHE  
INSTITUT**

Sprache. Kultur. Deutschland.



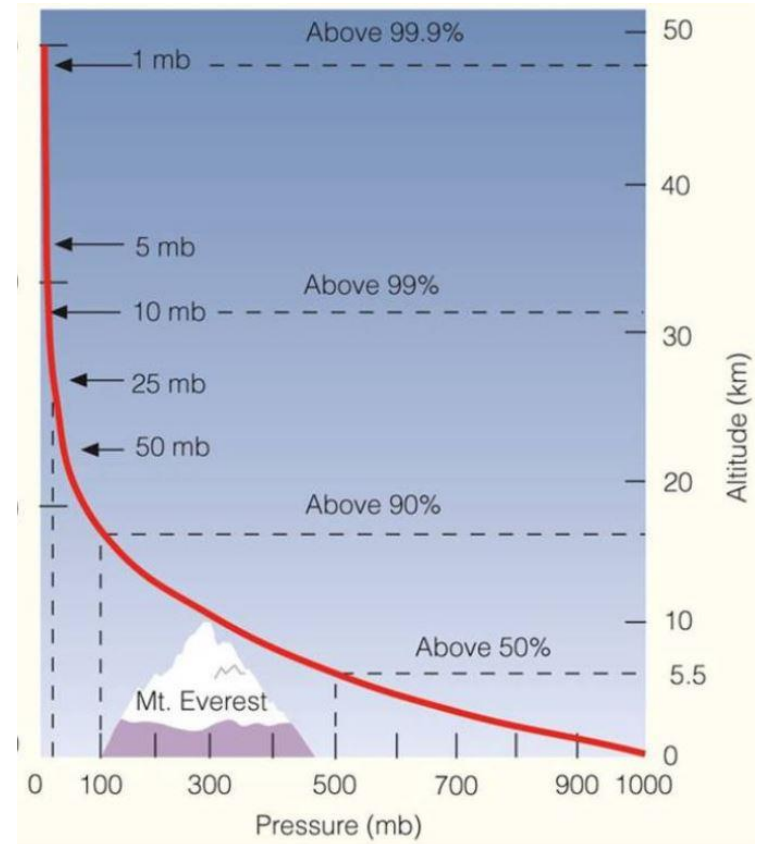
# Atmospheric thin film





# ATMOSPHERIC “THIN FILM”

- $P(z) = P(0) e^{-z/H}$
- At 5 km Atmos P ca 50% surface
- Average temperature ca  $-50^{\circ} \text{C}$
- Virtually all life below 5km
- We live in the “thin film”
- Our existence depends on the physical and chemical properties of the atmosphere e.g. the
- ***“Natural Greenhouse Effect”***



## PAPATŪĀNUKU – MOTHER EARTH – ‘WEB OF LIFE’

- In the Māori world view, land gives birth to all things, including humans, and provides the physical and spiritual basis for life.
- Papatūānuku, the land, is a powerful mother earth figure who gives many blessings to her children.



Photo © Dave Lowe

# EARTH SYSTEM SCIENCE “EQUILIBRIA”

Seite 6

- “natural cycles”  $H_2O$ , C and  $N_2$
- Net primary productivity  
plant C storage > 100  
billion tonnes/yr

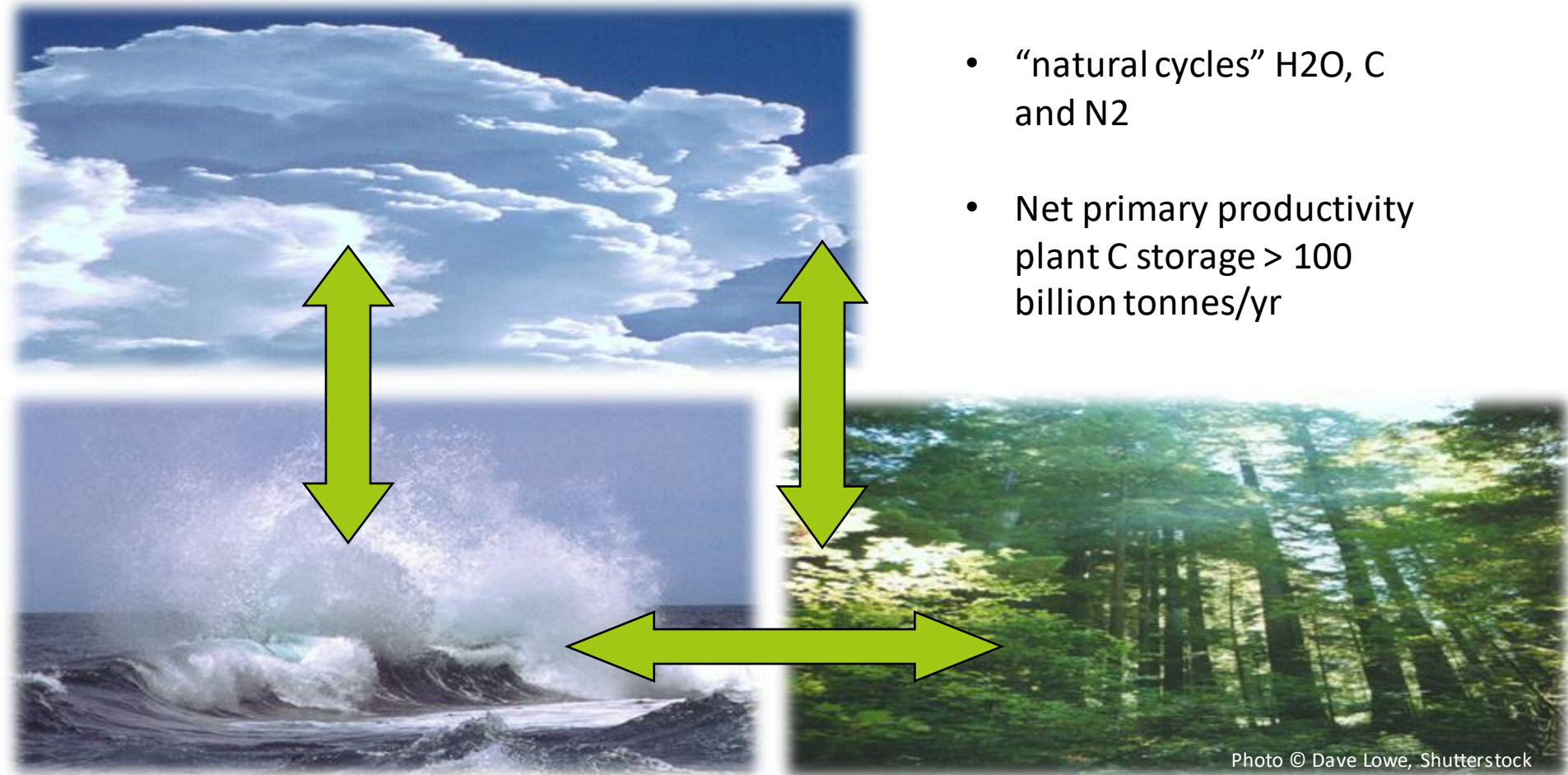
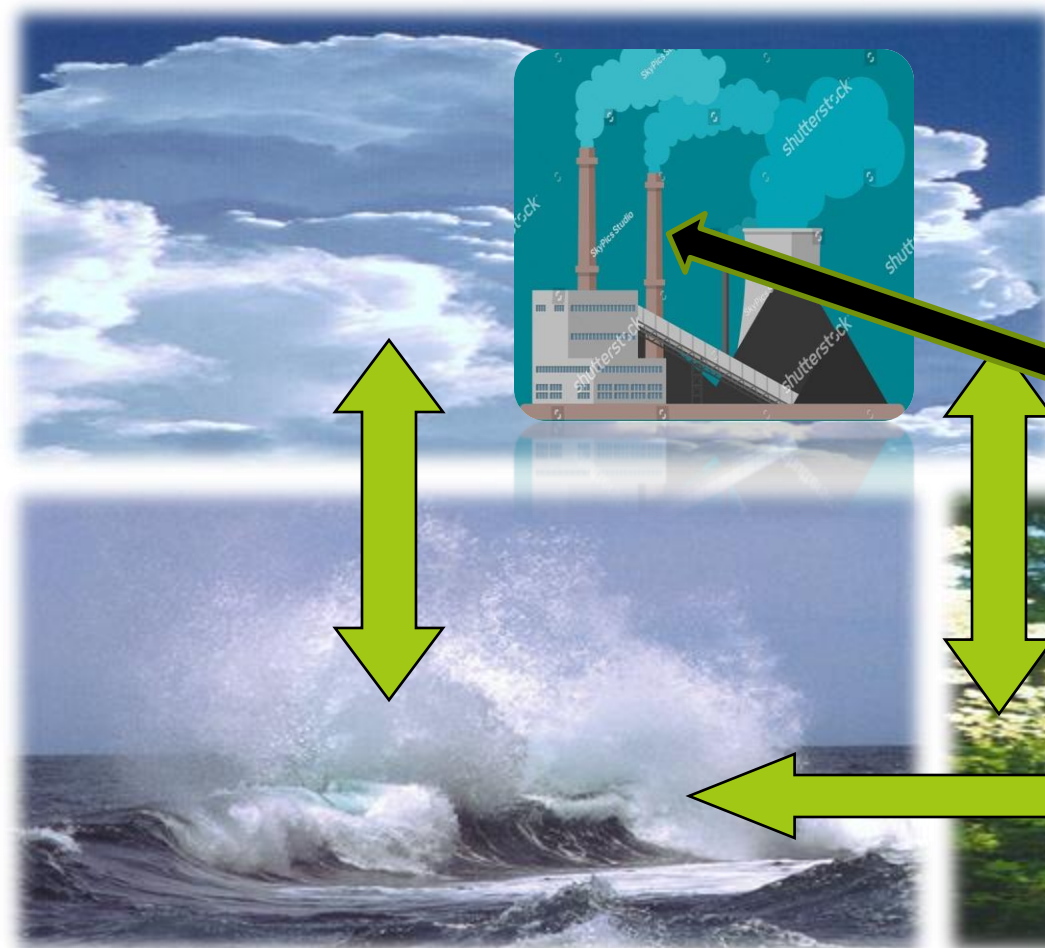


Photo © Dave Lowe, Shutterstock

# EARTH SYSTEM SCIENCE “EQUILIBRIA” CHANGED!

Seite 7



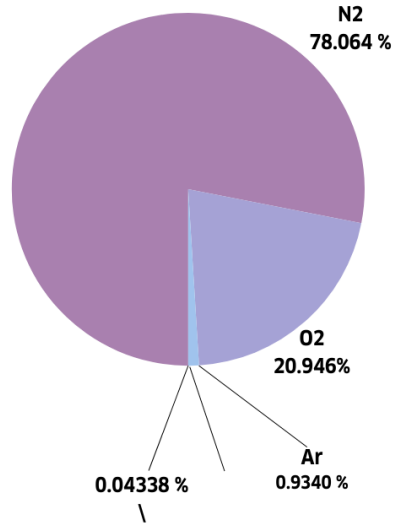
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- Net primary productivity plant C storage > 100 billion tonnes/yr

In 2020 humans added about 40 billion tonnes  $CO_2eq$ !!

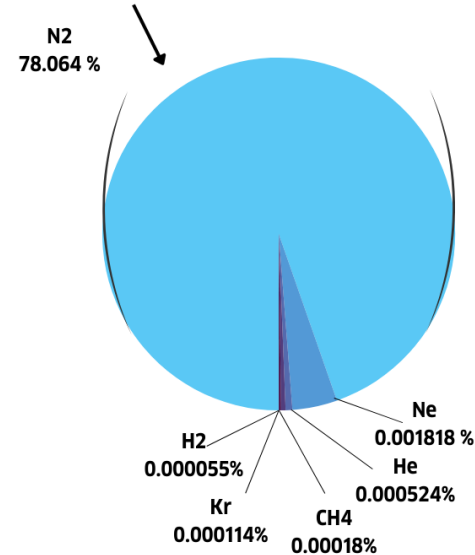


Photo © Dave Lowe, Shutterstock

# THE ATMOSPHERE IS AN AMAZING PLACE - 'TRACE GASES'



More than 99% of the dry atmosphere consists of three 'main gases' nitrogen, oxygen and argon. These don't do anything – not involved in atmospheric chemistry.



Less than 0.1% of the atmosphere consists of 1000's of 'trace gases'. These are vitally important for life. 'Natural Greenhouse Effect' warms Earth by 33°C – amplifies effect of water vapour.



# POSSIBLE HUMAN INFLUENCE ON EARTH'S GREENHOUSE EFFECT?

THE  
LONDON, EDINBURGH, AND DUBLIN  
PHILOSOPHICAL MAGAZINE  
AND  
JOURNAL OF SCIENCE.

[FIFTH SERIES.]

APRIL 1896.

XXXI. *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground.* By Prof. SVANTE ARRHENIUS \*.



Photo © Freemages

Av. surface Temp 15°C due to water vap. and CO<sub>2</sub>

Doubling CO<sub>2</sub> increase surface temp by 5°C

Estimated 3000 yrs for 50% [CO<sub>2</sub>] increase

## POSSIBLE INFLUENCE OF CARBON EMISSIONS ON THE EARTH'S GREENHOUSE EFFECT AND CLIMATE?

Since the industrial revolution 250 years ago humans have been releasing increasing amounts of CO<sub>2</sub> into the atmosphere

In the 1800s a couple of scientists including Swedish Professor Svante Arrhenius thought that this could cause a problem in the distant future.

He calculated that it would take 3000 years for atmospheric CO<sub>2</sub> to increase by 50%

But by burning more and more coal, oil and gas we have done this in only 200 years! – in that time it has gone up from 280 to 420 ppm.

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## SVANTE ARRHENIUS AND GRETA THUNBERG

Greta Thunberg the Swedish schoolgirl climate change activist is distantly related to Svante Arrhenius

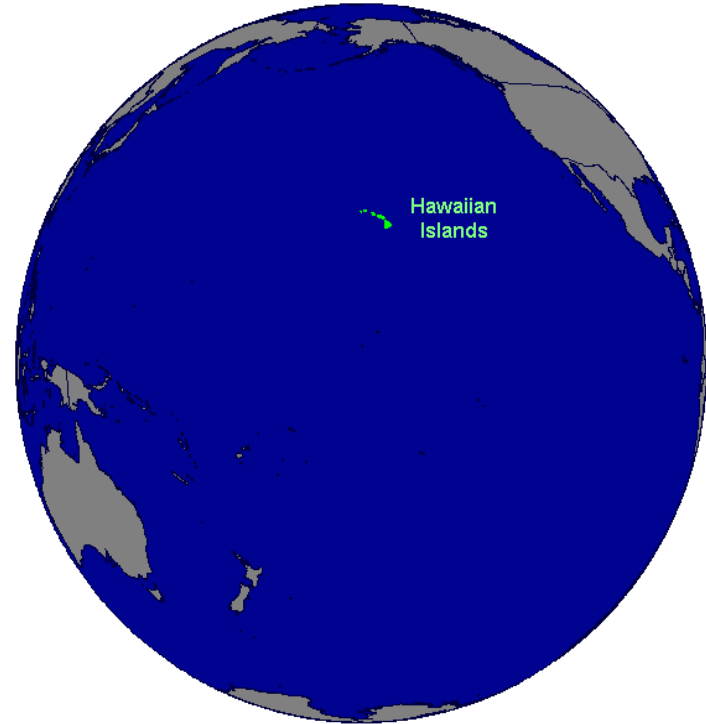
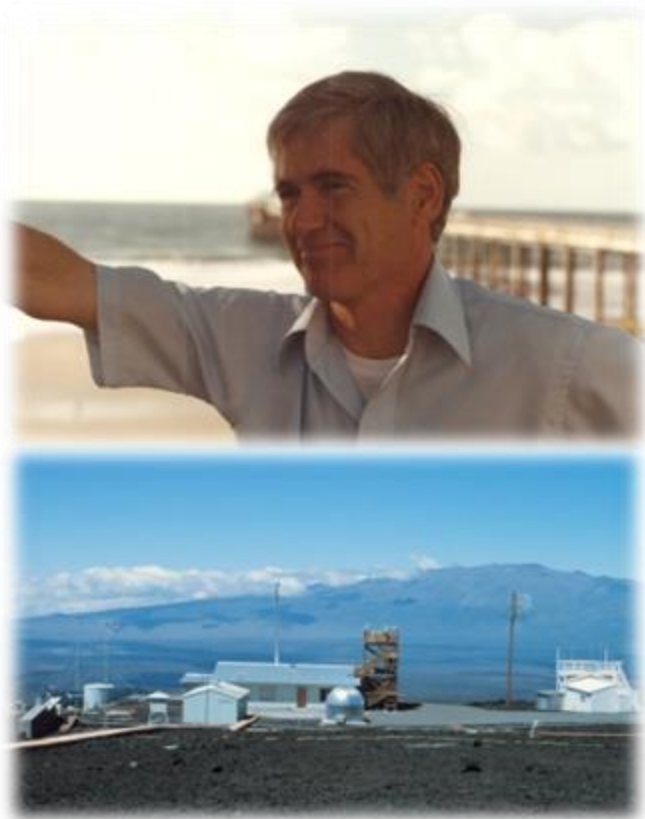
Svante Arrhenius won a Nobel prize for his scientific work in the early 1900s and Greta Thunberg was nominated for the Nobel peace prize in 2021

Greta Thunberg has energised young people around the world for action to reduce carbon emissions to 'save the planet'

Her inspiration has resulted in positive action in both New Zealand and Germany as well as many other countries.

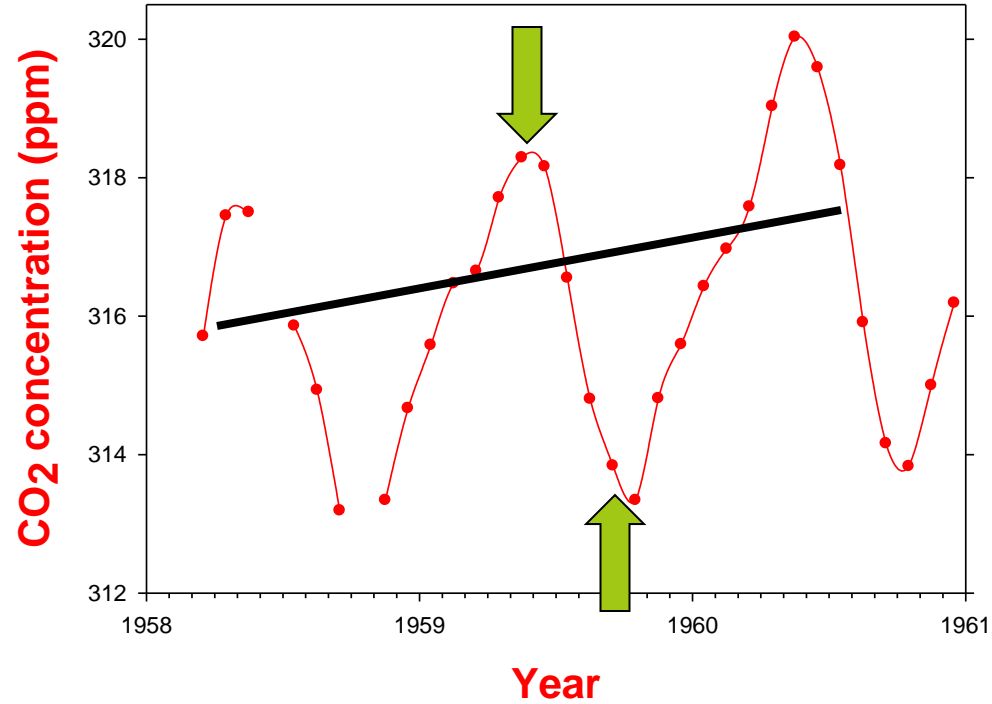


## FIRST CONTINUOUS ATMOSPHERIC CO<sub>2</sub> DATA MAUNA LOA, HAWAII





## THE EARLY MAUNA LOA CO<sub>2</sub>-RECORD



## WAS INCREASING ATMOSPHERIC CO<sub>2</sub> A GLOBAL ISSUE?

Mauna Loa atmospheric CO<sub>2</sub> data of fossil fuel usage showed that ca 50% stayed in the atmosphere

Southern Oceans a sink for 'excess' CO<sub>2</sub>? Keeling visited NZ in 1961 looking for air sampling sites.

Serendipity: In 1970, 23 year old Dave Lowe hired by Keeling and DSIR to make the first continuous atmospheric CO<sub>2</sub> measurements in the Southern Hemisphere

**- his life changes for ever!**



Photo © GNS Science New Zealand

# BARING HEAD: LONGEST CONTINUOUS MEASUREMENTS OF ATMOSPHERIC CO<sub>2</sub> IN THE SOUTHERN HEMISPHERE: 1972 TO THE PRESENT

Photo © Dave Lowe



# THE BEGINNINGS OF THE NZ ATMOSPHERIC CO<sub>2</sub> PROGRAMME

- Programme began at Makara Post office radio station in 1970.
- Arduous conditions – huge workload and responsibility for a 23 year old - my first science job!
- Worried about what the measurements meant – no one to talk to - constant exhaustion led to mental, physical and marriage breakdown



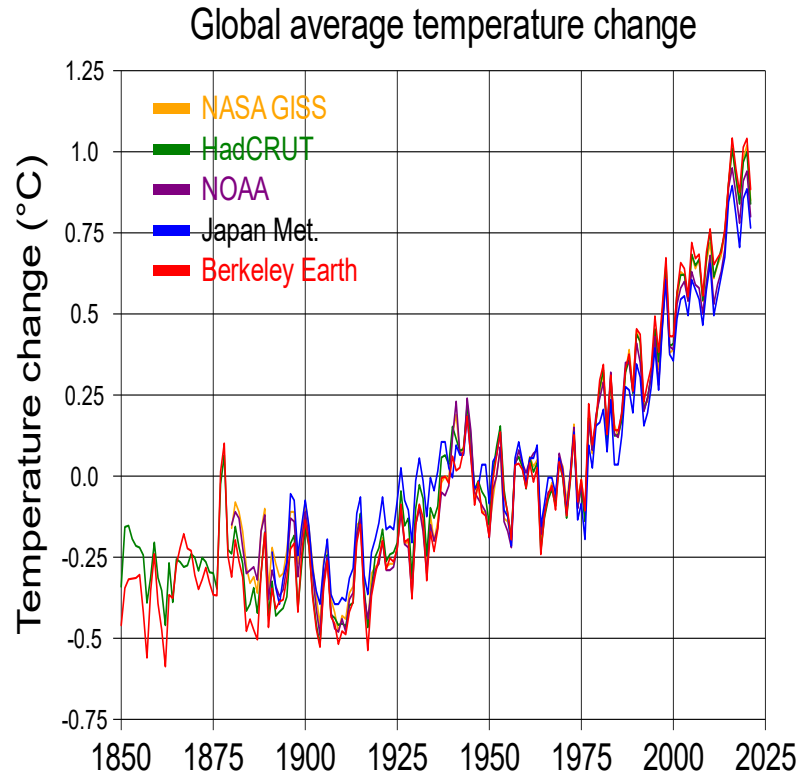


## HUMANS ARE CHANGING EARTH'S RADIATION BALANCE

- Due to “enhanced” greenhouse effect Earth receives more energy from the sun than lost to space – energy imbalance.
- Most of this extra energy in the oceans ca 90%. Earth regains its energy balance by increasing global average temperatures
- Extra energy due to ‘enhanced’ greenhouse effect is huge!
- 15 million TWh in 2021 about 1000 times output all power plants!
- Last deglaciation took about 6000 yrs. Current climate change from a geological perspective is like an explosion!

***Humans are “planet changers” ...the Anthropocene***

# CLIMATE EMERGENCY DRIVEN BY HUMANS!



## Effects already observed

- Increased droughts, floods and landslips
- Changes in atmospheric circulation
- Sea-level rise
- Many coral reefs disappearing
- Heatwaves and other effects making parts of the Earth uninhabitable for humans

***Sadly the list goes on!***

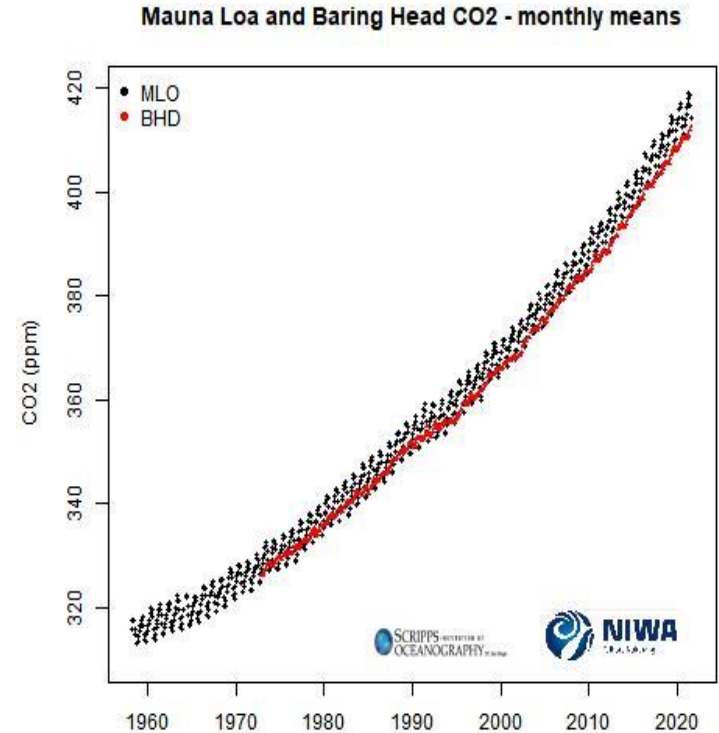
***The severity of all these effects is critically dependant on what happens with carbon emissions over the next 10 years!!***

## WHAT'S HAPPENED SINCE THE PARIS ACCORD IN 2015

- Atmosphere CO<sub>2</sub> and methane levels at Baring Head and worldwide continue to climb as emissions continue to increase!
- “Business as usual” implies inevitable dangerous climate change with catastrophic implications for Earth’s ecosystems!
- We are facing a climate emergency – June 2022 IPCC report concludes emissions must peak by 2025 and deep cuts must begin this decade if we are to achieve the Paris 1.5°C target. Recent NZ sea-level rise report shows immediate action required.

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- We are facing a climate emergency - emissions must peak by 2025 and deep cuts must begin this decade if we are to stay below the Paris 1.5°C target.





## NZ'S C EMISSIONS 'TALL POPPIES' – TRANSPORT AND AGRICULTURE

Photo © Dave Lowe



# THE FUTURE OF AGRICULTURE? TEN BILLION PEOPLE CAN'T EAT BEEF!

Seite 22

Photo © Dave Lowe



- Worldwide plant-based diet would reduce global agricultural land use from 4 to 1 billion hectares
- Combining solar electricity generation and agriculture
- Solar electricity to sugar conversion more efficient than farming sugar beet!

**Innovation has the potential to revolutionise farming but 'far sightedness' needed!**



## THE 'RIGHTS OF THE INDIVIDUAL' VERSUS THE 'NEEDS OF THE MANY?'

The amount of planet-heating CO<sub>2</sub> produced by the 330 million SUVs on the world's roads rose to about 1 billion tonnes in 2022. To put that in perspective, if SUVs were a country, they would easily be in the top 10 world's highest carbon-polluters.

In New Zealand and Germany anyone with a driver's licence has the right to drive a big petrol or diesel SUV. But this damages the atmosphere causing climate change problems for other people especially those living on low lying Pacific islands.

Should people be allowed to drive SUVs?  
Should there be regulations to limit emissions?  
Does this affect people's rights?



## REDUCING CARBON EMISSIONS IMPLIES CHANGING HABITS WHAT ARE YOU PREPARED TO DO?


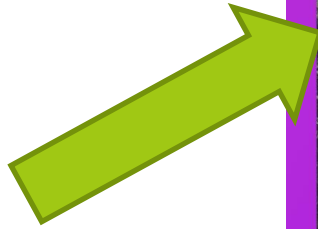
- Half NZ greenhouse gas emissions come from agriculture. This can't continue – future of pastoral farming?
- Plant based protein products now widely available in NZ supermarkets. These can be made into hamburgers and bolognaise sauces that look and taste like meat but are much cheaper and better for the planet.





# REDUCING CARBON EMISSIONS IMPLIES CHANGING HABITS WHAT ARE YOU PREPARED TO DO?

**Futurefit.nz -  
carbon calculator for  
New Zealanders**



## DISCOVER YOUR IMPACT ON THE PLANET


Get an idea of the impact of your lifestyle on our planet and see how your everyday actions can make a difference.

Take 5 minutes to get a snapshot of your footprint or stay longer to choose new actions, challenge friends, track and share your progress to become Future Fit.


[Go to dashboard »](#)

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**GEN LESS**



## TRANSPORT - ELECTRIC VEHICLES IN NEW ZEALAND

- In an EV more than 95% of battery energy converted into kinetic energy ie motion!
- Because NZ electricity production ca 85% renewable, if you have to drive a car, quickest way a New Zealander can reduce personal CO2 emissions is to use an EV.



Photo © Wellington Regional Council



Photo © Hutt City Council



Photo © Dave Lowe

# TRANSPORT .. ROLE OF BIKES AND ELECTRIC CARGO BIKES



## ONE ATMOSPHERE, ONE DECADE, ONE LAST CHANCE?

- To meet Paris accord temperature targets, net carbon emissions need to halve by 2030 and reach zero by 2050
- NZ one of first countries to have a zero carbon act in law
- Independent NZ climate change commission good news.
- But emissions reductions must begin immediately!



## Insight

## NATIONAL PORTRAIT

## ‘I’ve lived this horror for 50 years’

The Kiwi who helped prove man-made climate change came to science from his high school dropout surf board. Joel MacManus talks to Dave Lowe.

There's a certificate on the wall of Dave Lowe's small cottage in Petone, near Wellington. It's tucked away in the back office, an A3 piece of paper in an ordinary wooden frame.

It could easily be missed by a passing guest. But if they cared to take a second glance, three words would immediately jump out: Nobel Peace Prize.

It's the 2007 prize, awarded to the Intergovernmental Panel on Climate Change. Lowe was a lead author on its largest-ever report.

It was by far the greatest honour of his career. He resigned almost immediately afterward, walking away on top of the



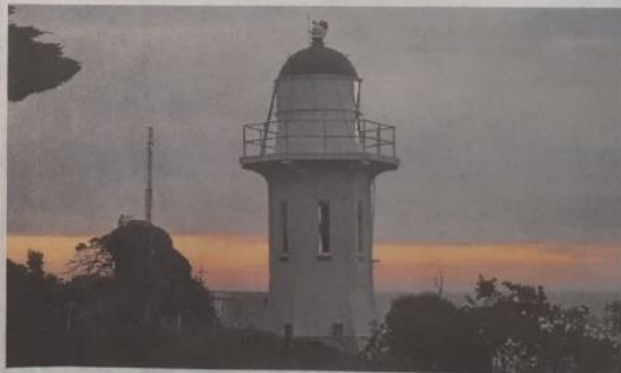
Dave Lowe taking an air flask sample at the edge of the Baring Head cliff, near Wellington, in 1972.

In autumn, as the leaves died off the trees, the amount of CO<sub>2</sub> in the air would rise.

Then in spring, as the plants grew again, the number would fall. In and out, like lungs exhaling.

longboards were the only equipment available. But Lowe was hooked.

"There was just a small bunch of us, really weird characters, and I was just fascinated with it," he says. "You go out there and man, do you get a feeling of



The sun setting behind the Baring Head. Atmospheric carbon measurements are still taken there to this day.

millions by the National Science Foundation."

But that work was for nothing. The readings at Makara were erratic, showing wild swings and no discernable pattern. That was a problem. There was no way to

contributions to the global record of climate change were invaluable.

"At the time I suspect it wasn't appreciated just how important the Baring Head station was, but now the

Germany to study further, and met his now-wife Irena. They've been married for 40 years.

He specialised in isotopic techniques, which he describes as like DNA tracing for gas particles.

Not all the CO<sub>2</sub> in the atmosphere is from the burning of fossil fuels. For most of human history, the CO<sub>2</sub> level has naturally fluctuated between 200 and 300ppm, which we know thanks to air samples trapped in glacier ice cores.

Those natural fluctuations are often cited by climate change deniers to suggest that warming is not man-made.

Naturally occurring carbon is made up of different isotopes. The most common types are called Carbon-12 and Carbon-13.

Carbon-12 is by far the most common type found in nature. Carbon-13 makes up about 1 per cent of the total. But the exact amount can differ. There is slightly less Carbon-13 in fossil fuels like coal and oil compared to in atmospheric carbon.

Lowe and other international researchers found that, while total CO<sub>2</sub> in the air was increasing, the percentage of Carbon-13 isotopes compared with Carbon-12 was decreasing.



# THE ALARMIST

## FIFTY YEARS MEASURING CLIMATE CHANGE

DAVE LOWE



Photo © Dave Lowe

**The Alarmist Fifty Years Of Measuring Climate Change  
by Dave Lowe**

**ISBN/SKU: 9781776564187**