

Reporting Live CO₂ Levels

This short report is written with the support of the University of Cambridge, Cambridge Zero, the Grantham Institute and Reading Department of Meteorology.

The purpose of this report is to help news and weather publishers and broadcasters to meaningfully communicate global levels of CO₂.

Why?

“We are in a planetary emergency.”

- Professor James Hansen, Former Director, NASA Goddard Institute for Space Studies

“Based on sober scientific analysis, we are deeply within a climate emergency state but people are not aware of it.”

- Professor Hans Schellnhuber, Founding Director of the Potsdam Institute for Climate Impact Research

“There is sufficient evidence to draw the most fundamental of conclusions: now is the time to declare a state of planetary emergency. The point is not to admit defeat, but to match the risk with the necessary action to protect the global commons for our own future.”

- Professor Johan Rockstrom, Director of the Potsdam Institute for Climate Impact Research

“This is an emergency and for emergency situations we need emergency action.”

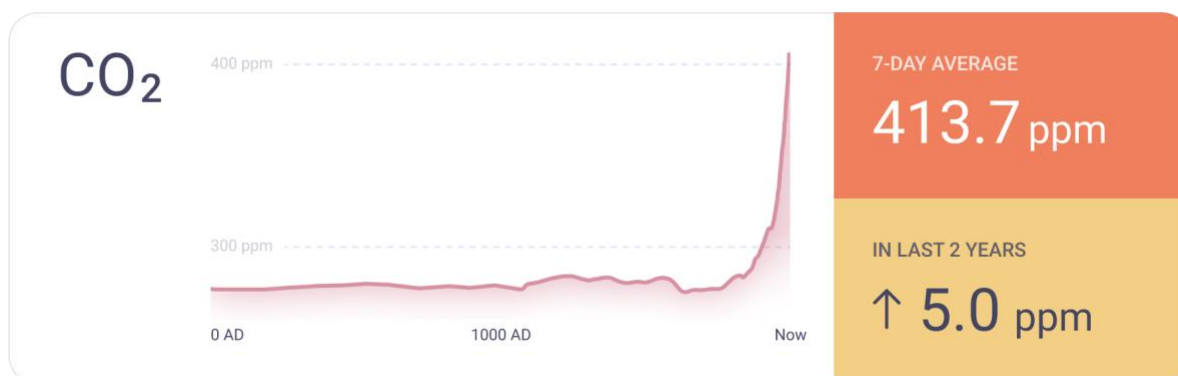
- Ban Ki-Moon, Former UN Secretary-General

The global level of CO₂ is the number that controls the future of the world, and accessibly communicating its historical context communicates urgency like nothing else. Clearly displaying its rate of change provides a unifying target for humanity.

This should be household information. It has rarely been so important to inform the public, now that so many livelihoods and lives are at stake.

How?

This report primarily recommends the inclusion of an animated widget similar to the static image shown below, in both daily broadcasts and highly visible locations on news websites.



The pages below offer justifications, ideas and the names of key people and organisations.

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1) Summary

Rapidly rising CO₂ levels are an existential threat.

News organisations around the world, from Bloomberg to the Guardian, have begun to regularly publish information about the level of CO₂ in the atmosphere, however, for many, the level of CO₂ remains an abstract, inaccessible concept.

This report is written with the expertise of scientists and science communicators and outlines a suggestion for how news and weather publishers can simply and clearly communicate a daily update of global CO₂ levels.

2) Data Sources

SCRIPPS and NOAA are two operationally independent schemes, both running at the Mauna Loa Observatory in Hawaii, providing hourly CO₂ values.

The atmosphere is global, and local measurements of CO₂ are of little relevance. These two schemes are considered by the scientific community to be the global standard for CO₂ levels. Their data is readily available for broadcasters and publishers.

Dr Heather Graven at the Grantham Institute is happy to answer questions about NOAA and Prof. Ralph Keeling at University of California, San Diego is happy to answer questions about SCRIPPS.

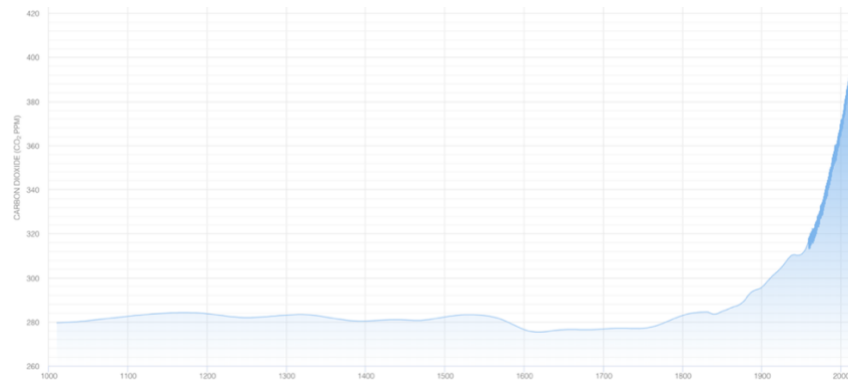
Please get in touch to discuss the technicalities of using this data.

3) Key Barriers & Solutions

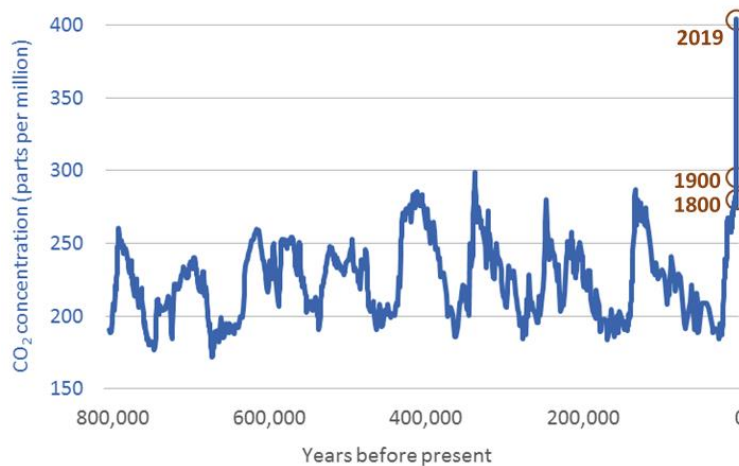
Presenting CO₂ levels needs to be done in a way that is easily understandable, communicates an unambiguous message and provides good context. There are three main barriers.

A. Historical Context

The following chart shows the global CO₂ concentration for the past 1000 years:



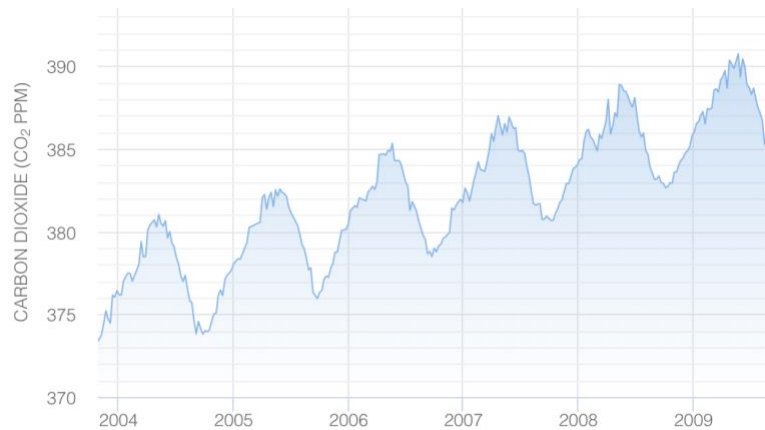
It is clear from this chart that current levels of CO₂, and the rate at which they're rising are both abnormal. The following chart shows the global CO₂ concentration for the past 800,000 years:



This historical context is important. Without clear historical context, a current day value (e.g. 414.7 ppm) may be of little meaning to many viewers.

Solution: CO₂ readings should be accompanied with simple, graphical visualisations, showing present-day values in an historical context, making clear that rapidly rising emissions are a modern phenomenon.

B. Annual Cycles



CO₂ levels oscillate annually, due to a number of biological and atmospheric factors.

As such, providing CO₂ concentration without some degree of annual context could be misleading. For example, from June onwards it may appear as if long-term CO₂ levels are falling.

Solution: Readings should be shown relative to the same reading one or two years prior.

C. Noise (Daily Fluctuations)



Day-to-day values can vary significantly, due to atmospheric effects.

This is problematic for two reasons:

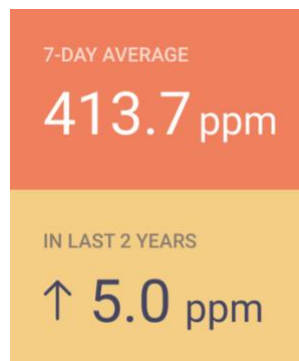
- Short-term fluctuations are of minimal importance relative to the overall trend of increasing CO₂. Showing these small fluctuations may cause viewers to believe that these fine details are of major significance.
- This noise leads to a higher chance of anomalous *apparent* changes in CO₂ concentration when compared to previous years. For example, an anomalously low present-day

reading could match up with an anomalously high reading in a previous year, making it look as though CO₂ levels have barely changed, or even dropped, when in fact the overall trend is the opposite.

Solution: Daily CO₂ readings should be given as the “7-day average” of today and 6 days prior. Due to measurements coming from the Hawaiian timezone this would often have to be the previous 7 days available.

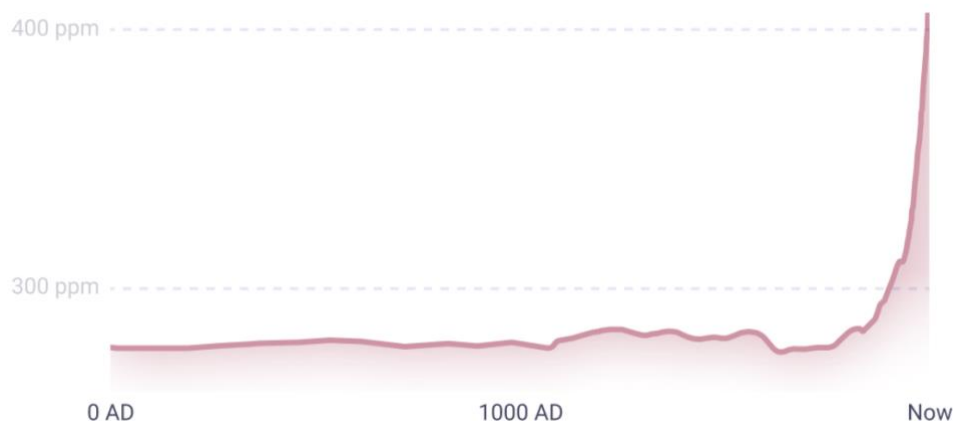
4) Conclusions For Displaying CO₂ Levels

CO₂ concentrations should be shown as clear, 7-day-averaged values, drawn from both the SCRIPPS and NOAA schemes. Furthermore, to avoid people mistakenly thinking that conditions might be improving in the latter half of each year, a ppm difference relative to the averaged value from two years prior should also be given.



Alternatively, a ppm difference relative to the previous year could be shown, however this could very occasionally result in apparent drops in CO₂ concentration, due to noise in the data, which could be misleading to viewers. (A full analysis of the data could be done to assess.)

Finally, to ensure that daily numbers can be digested in a historical context, they should be displayed with a short visualisation making clear the historical context of CO₂ levels, and how much they have changed since the industrial revolution.



This visualisation would likely be most effective if it began by showing CO₂ levels from the distant past (perhaps going as far back as 800,000 years), moving towards the present day and finally revealing the most recent 200 years of CO₂ concentrations.

5) Key Links & Contacts

Contact details for all of the below are available on request.

Cambridge Zero are assembling the world's brightest and best to create a zero-carbon future.

<https://www.zero.cam.ac.uk/>

SCRIPPS and the "Keeling Curve" measure and publish daily updates of global CO₂ levels.

<https://scrippsco2.ucsd.edu/> & <https://scripps.ucsd.edu/programs/keelingcurve/>

NOAA measure and publish daily updates of global CO₂ levels.

<https://www.esrl.noaa.gov/gmd/ccgg/trends/monthly.html>

The 2 Degrees Institute publish daily updates of global CO₂ levels, and are leading the way in doing so accessibly.

<https://www.co2levels.org/>

The Grantham Institute delivers world-class research, training and innovation towards effective action on climate change and the environment.

<http://www.imperial.ac.uk/grantham/>

6) Further Ideas (Appendix)

The following are a few further ideas to compliment communication of CO₂ levels.

Some have been the subject of healthy debate between those supporting this report. They are less meant as recommendations and more as inspiration.

A. Record Highs & Streaks

A potential downside of smoothing the CO₂ data with 7-day averages is that readings will generally only change by a small amount each day and may, after a time, not seem newsworthy to viewers.

The seemingly slow change could be countered with a “Record High” badge, displayed on days when the CO₂ concentration is at a record peak for that given date. At the going rate, this badge would appear on most days.

The wording “Record High” is preferable over “Highest Ever”, because the displayed CO₂ reading would be...

- the highest for the past 800,000 years (certainly), and most probably the highest for the past 3 million years, but perhaps not prior.
- the highest for that specific point in the year, though this may be lower than the reading shown yesterday, since global CO₂ levels fall in the latter half of the year.

An “Annual Peak” badge could be shown at the seasonal maximum in May, to further highlight the periodic nature of CO₂ levels, and to provide an event around which additional, related features could be published.

News and weather broadcasters may choose to further compliment a “Record High” badge with a number showing the “streak” or number of consecutive days that a record high has been reached, so that viewers can see the streak increasing every day.

B. Gamification of 2-Year Change

In order to engage and energise people further, the IN LAST TWO YEARS section of the widget could be gamified. This is the number that will most clearly represent progress or lack thereof.



This value often reads above +4ppm. Bringing this value down to +3ppm, +2ppm, +1ppm and hopefully into the negative numbers should be clearly outlined as a target, and celebrated.

C. Global Temperature

CO₂ levels could be linked to current global temperatures using the University of Oxford's Environmental Change Institute's Global Warming Index clock.

<https://www.globalwarmingindex.org/>

The advantage of this clock is that it relates the current level of atmospheric CO₂ with a verifiable temperature rise. Two disadvantages are 1) that the temperature rise may seem misleadingly small to some viewers and 2) that the number provides no indication of the danger of impending tipping points which could lead to runaway heating.

D. Future Context & Attribution

It would be compelling to link approaching CO₂ ppm horizons with exact, tangible consequences, however, this is tough to do with perfect accuracy due to the many unknowns involved.

It might at first seem reasonable to consider CO₂ concentrations from the distant past, and link present and approaching CO₂ values with temperatures from those times, but the resolution of such data is low, and global temperatures are the result of a complex interplay between various atmospheric gases, surface conditions, the biological state of the planet, cycles of the sun, latency factors and more, so it might be hard to defend these statements.

Another option is to link current and future CO₂ concentrations with projections of how much more likely extreme weather events are and will become.

Myles Allen and Friederika Otto's work at the University of Oxford on the World Weather Attribution project compares past databases with current weather patterns, to link the likelihood of extreme weather events with climate change.

<https://www.worldweatherattribution.org/>

This work could be utilised by news and weather publishers and broadcasters, such that global and weather events can be coupled with statements like "a downpour of this intensity was ___ times more likely to occur due to the effects of climate change".

Two other organisations doing complimentary work are:

1. End Climate Silence is a group campaigning for clearer association of news and weather stories with the climate trends driving them:
<https://www.endclimatesilence.org/>
2. The Climate Signals project has a wealth of information about the relationship between climate change and extreme weather events, seasonal shifts, atmospheric trends,

landscape changes etc.:

<https://www.climatesignals.org/climate-signals>

E. Ideas For Features

A key message that needs to be communicated to the public is that, even if the entire planet focuses on reducing CO₂ emissions, it could still take many years before levels are seen to be reducing. Combating the climate crisis will be like turning around a huge cruise ship. It will take time and perseverance. Effective, ongoing communication should involve the expertise of behavioural psychologists, to ensure that people remain motivated.

A second message that urgently needs communicating is the importance of biodiversity and healthy natural eco-systems in absorbing and storing carbon. For most people, there is still a disconnect between the climate crisis and the ecological crisis, leading to lack of urgency in addressing the latter, and a more dire situation in addressing the former.

Further to these two key messages, here is a short list of topics that could be addressed in monthly or annual roundups of CO₂ levels:

1. What causes the annual increase in CO₂ levels?
2. What causes the seasonal “wobbles” of CO₂ levels?
3. Has the seasonal cycle of CO₂ changed recently?
4. Why are CO₂ levels different in the Northern and Southern Hemispheres? (The North is, on average, 5ppm higher than the south.)
5. What is the CO₂ concentration in London compared to Hawaii? (Imperial College London is also measuring CO₂ concentrations, but for several good reasons, it’s better to use the values from Hawaii)
6. How are CO₂ levels measured?

Information from such features could be compiled into running Q&As, to further inform the public.

Finally, an annual feature could be a roundup of top companies / countries contributing to emissions, and top companies / countries sequestering them. Explicit emissions could be compared, rather than % contributions to ppm, which are harder to judge. Also, this would provide a good opportunity to discuss non-CO₂ greenhouse emissions.

With regards to resources, SCRIPPS have “a trove of historical imagery” that they’re happy to share with news / weather publishers and broadcasters.

F. Extra Detail & Other Gases

For news and weather publishers and broadcasters keen to go further, the 2 Degrees Institute suggests the inclusion of:

- 1) A more detailed CO₂ graph, including a second layer showing daily values, behind the 7-day average.
- 2) Similar widgets and graphs to show levels of other gases like methane, NO_x, hydrofluorocarbons etc., to show that these gases are also breaking records, to the detriment of the stability of the biosphere.