

The Reading and the State

What the CO₂ number measures, and where the balance is restored

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Summary

Climate policy steers on one number: the CO₂ content of the air. In the vacuum.net reading that number is a reading of a state, not the state itself. The state is the closure of the meshes through which carbon and water go round. Two meshes stand open. The deep one is fossil carbon. The shallow one is soil, peat and wetland. The shallow mesh has an address, and people live on it. This essay sets out the numbers of both, shows that water level and carbon stock are one state read twice, and names the readings a village can take itself. Every calculation is written out in the text.

1. The number

Mauna Loa measured 431.44 ppm in June 2026. The forecast annual mean for 2026 is 429.4 ppm. The level in 1750 was 278 ppm. The rise is 151.4 ppm.

The radiative term follows from the standard logarithmic expression:

- ratio: $429.4 / 278 = 1.545$
- natural logarithm: 0.435
- term: $5.35 \times 0.435 = 2.33 \text{ W/m}^2$

This is a global mean. Over the whole surface of the Earth ($5.10 \times 10^{14} \text{ m}^2$) it comes to $1.19 \times 10^{15} \text{ W}$.

The annual account for 2024, from the Global Carbon Budget 2025:

- fossil carbon: 10.3 GtC
- land-use change: 1.3 GtC
- total: 11.6 GtC

One ppm of CO₂ equals 2.124 GtC. So 11.6 GtC is 5.46 ppm per year. The ocean takes up about 29% and the land about 21%. Roughly half stays in the air.

These numbers are not in dispute here. The question is what kind of thing the number is.

2. The net

The vacuum.net picture is a fishing net under tension. Strands wind around each other. Where a winding returns in phase, a mesh closes. A closed mesh holds its content: what goes round comes back. An open mesh does not hold. Its content drifts to wherever there is room.

Balance in this picture is closure. It is not a quantity that sits somewhere. It is the condition that what circulates returns.

Carbon circulates through meshes at several depths. Leaf and air close within a season. Soil closes over decades to centuries. Peat closes over millennia. Coal, oil and gas closed over hundreds of millions of years.

The CO₂ number counts the carbon that is not inside a closed mesh at this moment. It is the reading taken at the place where the unheld carbon collects. The open mesh and the carbon in the air are not two things with an arrow between them. They are one fact, read at two places.

That changes the question. The question is not how to push a number down. The question is which meshes stand open, where they are, and who lives on them.

3. Two open meshes

The deep mesh. Fossil carbon was wound in and closed for some 300 million years. It is being unwound at 10.3 GtC per year. This is the larger of the two openings.

The shallow mesh. Soils have lost about 133 GtC over 12,000 years of land use (Sanderman, 2017, top two metres). In ppm:

- $133 / 2.124 = 62.6$ ppm, gross

That is 41% of the size of the present rise of 151.4 ppm. The comparison is one of scale, not of bookkeeping. Part of that carbon was taken up by ocean and vegetation long ago. If the whole debt were repaid, ocean and land would return carbon to the air, and roughly half would show on the reading: about 30 ppm.

The shallow mesh is still opening. Land-use change adds 1.3 GtC per year. Drained peat alone accounts for about 3% of all greenhouse gas emissions (Evans, 2021).

4. The second reading: water

The same shallow mesh carries water. Where it stands open, water runs off instead of staying. That shows on a second reading: the heat at the ground.

Evaporating one millimetre of water per day from one square metre:

- mass: 1 kg per m² per day
- latent heat: 2.45 MJ/kg
- seconds per day: 86,400
- flux: $2,450,000 / 86,400 = 28.4$ W/m²

One millimetre per day carries 28.4 W/m². That is twelve times the global CO₂ term of 2.33 W/m², at the place where it happens. Where the water is gone, that energy stays at the ground as heat.

The global size of this reading:

- Land-cover change has reduced terrestrial evaporation by about 3,500 km³ per year, or 5% (Sterling, 2013). A second reconstruction finds $1,260 \pm 850$ km³ (Boisier, 2014).
- 3,500 km³ is 3.5×10^{15} kg. Times 2.45 MJ/kg gives 8.6×10^{21} J per year. Divided by 3.16×10^7 seconds: 2.7×10^{14} W.
- Over the land surface (1.49×10^{14} m²) that is 1.8 W/m². Over the whole Earth it is 0.53 W/m².
- With the lower estimate: 0.66 W/m² over land, 0.19 W/m² over the whole Earth.

Since 1700 about 3.4 million km² of inland wetland has been drained, 21% of the total (Fluet-Chouinard, 2023). If each square metre of that area evaporates one millimetre per day less:

- $3.4 \times 10^{12} \text{ m}^2 \times 28.4 \text{ W/m}^2 = 9.7 \times 10^{13} \text{ W}$
- as a share of the CO₂ term: $9.7 \times 10^{13} / 1.19 \times 10^{15} = 8\%$

The two readings are different in kind. The CO₂ term is counted at the top of the atmosphere. The evaporation term is counted at the ground and says where the heat sits. On drained land, the heat sits where people and crops are. A hot summer on such land is to a large extent a storage reading.

5. One state, read twice

Peat shows most plainly that water and carbon are one state.

A drained peat meadow emits about 20 tonnes of CO₂ per hectare per year. In carbon:

- $20 \times 12/44 = 5.45 \text{ tC per hectare} = 0.545 \text{ kg C per m}^2$

Peat with a dry density of 150 kg/m³ and half its mass in carbon holds 75 kg C per m³. The loss in height:

- $0.545 / 75 = 0.0073 \text{ m} = 7 \text{ mm per year}$

The measured subsidence of Dutch peat meadows is 5 to 10 mm per year. The emission and the sinking of the ground are the same number in two units.

The water level sets both. Every 10 cm that the water table stands higher lowers the emission by at least 3 tonnes of CO₂-equivalent per hectare per year, down to a depth of 30 cm (Evans, 2021).

The Netherlands has 436,000 hectares of organic soil. Its peat meadows emit about 5 Mt CO₂-equivalent per year. The agreed reduction for 2030 is 1 Mt. In water level:

- $1,000,000 \text{ t} / 3 \text{ t per ha per 10 cm} = 333,000 \text{ hectare-steps of 10 cm}$
- that is a rise of 20 cm over 167,000 hectares

Mineral soils show the same unity, with a different weight on each side. One percentage point more organic carbon in the top 30 cm, at a soil density of 1,400 kg/m³:

- carbon: $0.30 \times 1,400 \times 0.01 = 4.2 \text{ kg C per m}^2 = 42 \text{ tC per hectare}$
- water: $1.16 \text{ mm per 100 mm of soil (Minasny and McBratney, 2018)} \times 3 = 3.5 \text{ mm}$

Forty-two tonnes of carbon per hectare goes with 3.5 mm of plant-available water. That is one summer day of evaporation. Soil carbon is a large carbon store and a small sponge. The water that matters is held by the water table, the ditch level and the wetland. The grip therefore lies with the water: where the water stays, the carbon stays.

6. What each mesh carries

Closing the shallow mesh has a ceiling. Soil carbon measures across cropland, grassland and peat can take up about 1.6 GtC per year (Bossio, 2020: a quarter of 23.8 GtCO₂e).

- $1.6 / 11.6 = 14\%$ of the annual total

The shallow mesh carries about one seventh of the carbon reading. It carries nearly all of the water reading. The deep mesh carries the rest of the carbon. It closes when burning stops. That is the subject of a separate text (Konstapel, 2026).

The two meshes differ in one respect that matters for action. The deep mesh is closed by a change in how energy is had. The shallow mesh is closed by hand, on a known piece of ground, within seasons.

7. The address

A ppm has no address. Nobody can touch it on their own land. A household that is told to lower a global mean is given a task with nothing to hold.

A mesh has an address. There is a farmer on the peat near Zegveld whose land sinks 7 mm a year and whose barn floor cracks. There is a village on the Hungarian sand ridge where the groundwater dropped from 6.5 to 8 metres in one year. There volunteers close off drainage channels and let meadows flood. There are water boards that set ditch levels every week.

What lives on such ground is concrete: cattle, meadow birds, the well, the harvest, the foundation of the house. What disappears with an open mesh is equally concrete. So is what returns when it closes.

Four readings exist already and can be taken locally:

1. groundwater level, in centimetres below the surface
2. height of the surface, in millimetres per year
3. summer surface temperature of the field against the neighbouring field
4. organic carbon in the top 30 cm

Together they say whether a mesh is closing. Each responds within one to five years. The global ppm responds to the sum of all meshes and cannot say which one moved.

A balance is restored where it can be read by the people who live on it.

8. Status

Established by measurement: the CO₂ level and its radiative term; the soil carbon debt; the wetland loss; the water-table rule for peat; the small water-holding effect of soil carbon.

Calculated here from those sources: 62.6 ppm gross; 28.4 W/m² per mm per day; 0.19 to 0.53 W/m² global evaporation term; 7 mm per year peat subsidence; 167,000 hectares at 20 cm.

Illustrative assumption: one millimetre per day less evaporation on drained wetland.

Reading from the net: the CO₂ number as a reading of open meshes; water level and carbon stock as one state.

Open: a closure index that combines the four local readings into one figure per catchment.

Annotated references

NOAA Global Monitoring Laboratory (2026). Trends in Atmospheric Carbon Dioxide, Mauna Loa. gml.noaa.gov/ccgg/trends *Why read?* The source of the number itself. Monthly values, method and uncertainty on one page.

Met Office (2026). Mauna Loa carbon dioxide forecast for 2026. *Why read?* Gives the annual mean (429.4 ppm) and shows how much of the yearly rise depends on El Niño and La Niña through tropical land. The reading already moves with the state of the land.

Friedlingstein, P. et al. (2025). Global Carbon Budget 2025. Earth System Science Data. *Why read?* The annual account: 10.3 GtC fossil, 1.3 GtC land use, the shares of ocean and land. Read the section on the budget imbalance of 2024. It shows how uncertain the land term is.

Sanderman, J., Hengl, T., Fiske, G. (2017). Soil carbon debt of 12,000 years of human land use. PNAS 114, 9575–9580. *Why read?* The 133 GtC figure and, more useful, the maps. They show where the debt lies: the main cropping regions and degraded grazing land. The debt has an address.

Fluet-Chouinard, E. et al. (2023). Extensive global wetland loss over the past three centuries. Nature 614, 281–286. *Why read?* 3.4 million km² lost, 21%, concentrated in Europe, the United States and China. Lower than earlier estimates, and better founded. Start with the regional maps.

Sterling, S., Ducharne, A., Polcher, J. (2013). The impact of global land-cover change on the terrestrial water cycle. Nature Climate Change 3, 385–390. *Why read?* The 3,500 km³ per year. Wetlands and reservoirs show the largest changes. The paper states that land cover alters runoff as much as other main factors.

Boisier, J. P. et al. (2014). Historical land-use-induced evapotranspiration changes. Hydrology and Earth System Sciences 18, 3571–3590. *Why read?* The lower estimate (1,260 ± 850 km³) and an account of why the estimates differ. Read it next to Sterling to see the width of the range.

Evans, C. D. et al. (2021). Overriding water table control on managed peatland greenhouse gas emissions. Nature 593, 548–552. *Why read?* The central rule of section 5: the water table overrides every other factor. Three tonnes per hectare per 10 cm. The paper also shows that productive use need not end.

Minasny, B., McBratney, A. B. (2018). Limited effect of organic matter on soil available water capacity. European Journal of Soil Science 69, 39–47. *Why read?* Sixty studies and 50,000 measurements. The sponge effect of soil carbon is small: 1.16 mm per 100 mm. A necessary correction on a widely repeated claim. *Reading advice:* compare with Libohova et al. (2018), who find somewhat higher values per percent organic matter.

Bossio, D. A. et al. (2020). The role of soil carbon in natural climate solutions. Nature Sustainability 3, 391–398. *Why read?* The ceiling of the shallow mesh: soil carbon as a quarter of the land-based potential. Useful for keeping the proportions straight.

Tweede Kamer (2020). Kamerstuk 32 813 nr. 562, Veenplan eerste fase. *Why read?* The Dutch commitment in the original: 436,000 hectares of organic soil, 1 Mt reduction in 2030, the budget attached. Shows how a national number is divided over provinces and then over polders.

NOBV / STOWA (2021–2024). Nationaal Onderzoeksprogramma Broeikasgassen Veenweiden, reports. *Why read?* The field measurements behind the Dutch peat figures. The programme states that conditions differ per region, per polder and per field. That is the address principle in practice.

Konstapel, J. (2026). Setting the State, Not the Screen. constable.blog. *Why read?* The same reading applied to solar dimming. Contains the first derivation of the 28.4 W/m² lever.

Konstapel, J. (2026). Closing the Mesh — The Hungarian Plain Is a Storage Problem, Not a Rainfall Problem. constable.blog. *Why read?* One catchment worked out in full: the storage account of the Homokhátság and the people who close the channels.

Konstapel, J. (2026). Where Electricity Comes From — The Full Vacuum and the End of the Fire Age. constable.blog. *Why read?* The deep mesh. What closing it looks like from the net.