**ESR NEWSLETTER**
**April 2025**

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## 1.From sewage and scum to swimming in ‘blue gold’: how Switzerland transformed its rivers

*Extracts from an article by Phoebe Weston in Geneva, Guardian website, 17 Mar 2025*

In the 1960s, Switzerland had among the dirtiest water in Europe, blighted by mats of algae, mountains of foam, scum, and dead fish floating on the surface. For decades, swimming was banned in some rivers such as the Aare and Limmat on health grounds, and people could get ill if they swallowed the water.

Raw sewage and industrial wastewater flowed directly into water bodies –in 1965 only 14% of the population was connected to a wastewater treatment plant. Today, it is 98%, and the country has a reputation for pristine swimming waters, sometimes referred to as its “blue gold”– and it’s all thanks to a complex network of sewage plants.

A key driver of that transformation was a tragedy in the mountain resort of Zermatt in 1963, when a typhoid outbreak killed three people and made 437 others ill. Pressure grew on the government to clean up the waterways, found to be the source of the outbreak. In 1971, the treatment of wastewater was written into Swiss law.

Now Switzerland has some of the cleanest rivers in Europe. According to 2023 data from the European Environment Agency, just five of the country’s 196 bathing areas were rated as poor quality. Politicians across the spectrum agree on the need to prioritise clean water.

“Very high water quality is important to the population,” says Michael Mattle, head of wastewater technology at the engineering company Holinger. “We take a lot of care not to pollute water on its way through Switzerland.” And they pay for it: the government spent an average of £174 a person on wastewater treatment in 2022, compared with about £90 a person in England and Wales in the 2022-23 financial year, according to analysis by Ends Report.

Now, Switzerland is leading the world in purifying its water of micropollutants: a concoction of chemicals often found in bodies of water that look crystal clear. They include antidepressants, antibiotics, diabetes treatments and anti-inflammatories, which have unknown and potentially damaging consequences for human and ecosystem health.

In 2016, Switzerland became the first country to enforce legislation to clean up drugs and chemicals that collect in waterways. This work is based on a precautionary principle – if something has unknown effects, err on the side of caution. “It’s just a matter of time before they cause problems,” says Mattle.

Conventional sewage treatment works are designed to deal with organic waste but are less effective with chemicals, hence plants across Switzerland are getting an upgrade.

The Villette wastewater treatment plant is Geneva’s first to treat micropollutants. The facility filters through 250 litres of water every second. First it filters out rubbish, food, money – anything people might flush down their toilets (a study found (£1.4m) worth of gold flows through Swiss sewers every year). Then fat and sand are removed before the water is treated in huge basins of bacteria that removes organic matter.

Then the water is passed through activated charcoal, which acts like a sponge, absorbing the microchemicals.

Each year, the Swiss are adding micropollutant treatment facilities to seven sewage plants, and now have a total of 37. By 2040, there will be about 140, according to unpublished data from the Swiss Water Association (VSA).

Before 2016, a series of pilots found removing 80% of pollutants was the maximum amount achievable for a reasonable cost. Within the 20% of chemicals that are not removed are PFAs, known as forever chemicals. Mattle says: “The endgame is to get these substances prohibited. Very resistant pollutants should not be used any more.”

Wastewater experts from France, Italy and Belgium among other countries, have visited the plant to see what lessons in micropollutant treatment they could take back home. “On micropollutants, we are 10 to 15 years ahead of our neighbours,” says Mattle.

In response to Switzerland’s work, the EU requires wastewater treatment plants serving more than 10,000 people to be able to remove micropollutants by 2045.

## 2. UK scientist wins prize for invention that could help avert 'phosphogeddon'

*From an article by Robin McKie,Science Editor, Observer (from Guardian website), Sun 2 Feb 2025*

It is one of the least appreciated substances on the planet and its misuse is now threatening to unleash environmental mayhem. Phosphorus is a key component of fertilisers that have become vital in providing food for the world. But at the same time, the spread of these phosphorus compounds – known as phosphates – into rivers, lakes and streams is spreading algal blooms that are killing fish stocks and marine life on a huge scale.

It is a striking mismatch that is now being tackled by a project of remarkable simplicity. The company Rookwood Operations, based in Wells, Somerset, has launched a product that enables phosphates to be extracted from problem areas and then reused on farmland.

This week one of the company's founders, Jane Pearce, will be awarded a £75,000 Innovate UK Women in Innovation Award for her role in setting up the project. "Our product has a straightforward goal – to transfer phosphates from rivers and lakes where they are causing real damage and move them in a simple manner to farmland, where they can be of use in growing crops," Pearce told the *Observer* last week.

The key to the intriguing transfer is a substance simply known as Phosphate Removal Material or PRM. Recently developed, it is about to undergo trials with a local water company in Somerset and these will be followed up in a few months with tests with a national company.

"Essentially, the PRM we have developed acts like a sponge that absorbs phosphates," said Pearce, who set up Rookwood Operations with her partner, Liam, and a friend, Josh Hares. "It sits in the water in an open container until it has absorbed as much phosphate as possible and it is then transferred to farmland. PRM is made entirely of natural materials, so it can be put on to a field and left there for its phosphate fertiliser to be taken up by crops. On its own, PRM will enhance the quality of the soil."

Phosphates are essential to life. Bones and teeth are largely made of calcium phosphate, while DNA has a phosphate backbone that provides crucial support for its structure. Yet the vital role of phosphates within fertilisers – about 50m tonnes of phosphate fertiliser are sold around the world every year and play a key role in feeding the planet's 8 billion inhabitants– means that phosphate reserves are drying up. Only those in Morocco, the western Sahara and China contain significant amounts, while reserves in the US are down to 1% of previous levels. Britain has always relied on imports.

Simultaneously, humanity has become dangerously profligate. Fertilisers are washed from fields, along with phosphate-rich sewage discharges, and these contaminate lakes

and waterways around the world. Phosphate run-offs trigger algal blooms that consume oxygen and block sunlight from underwater plants with deadly effects.

## 3. Nearly 100% of lithium recycled in latest research

*Extracted from Inside EVs article by Suvrat Kothari, 20 April 2025*

- Chinese researchers found a way to extract all the lithium from a dead battery for reuse.
- They discovered a special process to reduce costs, speed up recycling and prevent harmful byproducts from spilling into the environment.

As electric vehicle adoption increases, millions of end-of-life batteries will be up for recycling by the early 2030s. Improper disposal of these batteries can contaminate the planet with harmful chemicals. That's why researchers are racing to find solutions to maximize the recycling potential of EV batteries.

Now, Chinese researchers have found a way to recycle nearly 100% of the lithium in a battery, *The Independent* first reported, citing a study from the German academic journal *Angewandte Chemie*. They used a special technique to extract 99.99% of the lithium, 97% of the nickel, 92% of the cobalt and 91% of the manganese from a used battery.

Researchers said traditional extraction methods using amino acids cause safety issues and risk doing more environmental harm than good. Instead, they used an extraction technique called "neutral leaching." It replaces the harsh chemicals of traditional recycling with a neutral solution, apparently making the process safer and more eco-friendly.

It also saves time, with lithium, nickel, cobalt and manganese extraction taking just 15 minutes. The researchers also used a simpler amino acid called "glycine" to extract lithium more efficiently and then used a special process to avoid any further chemical reactions. As a result, the possibility of harmful byproducts is minimized. The study also says this process reduces recycling cost.

The study was conducted by multiple Chinese universities, including Central South University in Changsha, Guizhou Normal University and the National Engineering Research Center of Advanced Energy Storage Materials.

This may be a lab experiment, but battery recycling is still an untapped resource that could be worth billions of dollars over the years. It can even make new EV batteries that use recycled content significantly cheaper. In fact, a clause in the Inflation Reduction Act qualifies batteries recycled in the U.S. as American-made, making them eligible for subsidies regardless of the country of origin. That's part of the reason why the recycling industry in the U.S. is growing rapidly.

## 4. UQ researchers set new solar cell world record

*From an article in Energy Source & Distribution, April 17, 2025*

University of Queensland researchers have set a world record for solar cell efficiency with eco-friendly perovskite technology. A team led by Professor Lianzhou Wang has unveiled a tin halide perovskite (THP) solar cell capable of converting sunlight to electricity at a certified record efficiency of 16.65%.

Working across UQ's School of Chemical Engineering and the Australian Institute for Bioengineering and Nanotechnology, Professor Wang said the certified reading achieved by his lab was nearly one percentage point higher than the previous best for THP solar cells. "It might not seem like much, but this is a giant leap in a field that is renowned for delicate and incremental progress," Professor Wang said.

"The reading is in line with many silicon-based solar cells currently on the market but with the potential to be cheaper and quicker to make.

"The benefit of THPs is that we're dealing with more eco-friendly tin and not the toxic lead that is widely used in most of the perovskite solar cells, meaning they can be safely installed around the home." The use of tin precursor had previously been problematic because of the sub-standard quality of the fast-crystalline thin films used in manufacturing THP solar cells, leading to a dip in efficiency. Dr Peng Chen said the group overcame this hurdle by incorporating caesium ions to improve the microstructure and reduce defects in the THP film.

Professor Wang said the flexibility and versatility of THP cells—when coupled with improved efficiency—could make them the ideal candidate for household photovoltaic solar panels to be used both outdoors and indoors. "Beyond solar panels, the approach we've used in this paper could also be used for other devices that require high-quality perovskite films like lasers, photodetectors, and transistors," Professor Wang said. "We could eventually see THPs used for engineering challenges, including as a lightweight solution to power electric aircraft—the sky really is the limit."

## 5. Articles from Imagine Newsletter forwarded by ESR committee member Hugh MacMurray on 20 March 2015

*Imagine Newsletter is "a weekly synthesis of academic insight on solutions to climate change, brought to you by The Conversation" (imagine@theconversation.com).*

**Plants are losing their appetite**

"Microplastics are hindering photosynthesis, the process by which plants convert energy from the sun into the fruit and vegetables we eat," says Denis J. Murphy, an emeritus professor of biotechnology at the University of South Wales. "This threatens

**massive losses in crop and seafood production** over the coming decades that could mean food shortages for hundreds of millions of people."

These are the conclusions of a recent study by researchers in China, Germany and the US. Murphy wasn't involved, but his own research with plant cells – which the tiniest microplastics can infiltrate, and damage the organs involved in photosynthesis – has him worried.

"Given the potential (albeit speculative) risk to global food production, more priority should be given to rigorous scientific research of microplastics and their effects on both crops and the marine life that supports fish and seafood stocks," he says.

Not so long ago, people wondered if our fossil fuel habit might actually benefit plant photosynthesis. After all, plants eat $CO_2$. Flooding the atmosphere with more of it each year could only whet their appetites, right? "The amount of $CO_2$ used by photosynthesis and stored in vegetation and soils has grown over the past 50 years, and now absorbs at least a quarter of human emissions in an average year," say ecologists Amanda Cavanagh (University of Essex) and Caitlin Moore (University of Western Australia).

Most of this extra carbon absorption has come from crops and young trees, the pair say, less from mature forests where a lot of the world's carbon is stored. Cavanagh and Moore say this **carbon pump is slowing down**, as the other necessary ingredients for photosynthesis – soil nutrients and water – have fallen or stayed the same.

Microplastics could slow the rate at which plants remove carbon further.

And then there are the effects of climate change, like drought, fires and floods, which will intensify as long as we continue burning fossil fuels.  After monitoring forests and shrublands in Australia for 20 years, Moore and a team of six colleagues concluded that these ecosystems are at risk of **losing their ability to bounce back**, and continue absorbing carbon, after successive climate disasters

**Hacking photosynthesis**

We may have done plenty to reduce global photosynthesis, but a team of scientists at the University of Oxford and the Fraunhofer Society in Germany is trying to turn things around. How? By hacking plants to help them get more out of the process.

"You would be forgiven for thinking nature has perfected the art of turning sunlight into sugar," say Jonathan Menary, Sebastian Fuller and Stefan Schillberg. "But that isn’t exactly true. The team say that plants tend to convert less than 5% of sunlight into new tissue – often as little as 1%. That's because of a mistake plants regularly make, in which an enzyme involved in photosynthesis latches on to oxygen instead of $CO_2$."If we could prevent this mistake, it would **leave plants more energy for photosynthesis**," they say.

Cyanobacteria are Earth's most ancient photosynthesisers. Menary, Fuller and Schillberg say these microscopic organisms could possess useful genes for better

sunlight management that might benefit crops like rice and potato plants. Another technique involves helping plants recover from high light exposure quicker.

More efficient photosynthesis, with the help of gene editing and other tools, is not "a silver bullet", the team stress. Certainly not while fossil fuels continue to drown our green planet in carbon it cannot metabolise. However, this work is likely to prove useful as farmers seek to grow more in an increasingly volatile environment, while sparing enough land for nature.

## 6. WMO report documents spiralling weather and climate impacts

*Extracts from the WMO Press Release, 19 March 2025*

The clear signs of human-induced climate change reached new heights in 2024, with some of the consequences being irreversible over hundreds if not thousands of years, according to a new report from the World Meteorological Organization (WMO), which also underlined the massive economic and social upheavals from extreme weather.

**Key messages**

- Key climate change indicators again reach record levels
- Long-term warming (averaged over decades) remains below 1.5°C
- Sea-level rise and ocean warming irreversible for hundreds of years
- Record greenhouse gas concentrations combined with El Niño and other factors drive 2024 record heat
- Early warnings and climate services are vital to protect communities and economies

WMO's State of the Global Climate report confirmed that 2024 was likely the first calendar year to be more than 1.5°C above the pre-industrial era, with a global mean near-surface temperature of 1.55 ± 0.13 °C above the 1850-1900 average. This is the warmest year in the 175-year observational record.

WMO's flagship report showed that:

- Atmospheric concentration of carbon dioxide are at the highest levels in the last 800,000 years.
- Globally each of the past ten years were individually the ten warmest years on record.
- Each of the past eight years has set a new record for ocean heat content.
- The 18 lowest Arctic sea-ice extents on record were all in the past 18 years.

- The three lowest Antarctic ice extents were in the past three years.
- The largest three-year loss of glacier mass on record occurred in the past three years.
- The rate of sea level rise has doubled since satellite measurements began.

The report said that long-term global warming is currently estimated to be between 1.34 and 1.41 °C compared to the 1850-1900 baseline based on a range of methods.

The record global temperatures seen in 2023 and broken in 2024 were mainly due to the ongoing rise in greenhouse gas emissions, coupled with a shift from a cooling La Niña to warming El Niño event. Several other factors may have contributed to the unexpectedly unusual temperature jumps, including changes in the solar cycle, a massive volcanic eruption and a decrease in cooling aerosols, according to the report.

The WMO and the global community are intensifying efforts to strengthen early warning systems and climate services to help decision-makers and society at large be more resilient to extreme weather and climate. Only half of all countries worldwide have adequate early warning systems.

The report is based on scientific contributions from National Meteorological and Hydrological Services, WMO Regional Climate Centres, UN partners and dozens of experts. It is one of a suite of WMO scientific reports which seek to inform decision-making. It was published ahead of World Meteorological Day on 23 March, World Water Day on 22 March and World Glaciers Day on 21 March.

## Some Key Indicators

### Atmospheric Carbon Dioxide

Carbon dioxide concentrations in 2023 (the last year for which consolidated global annual figures are available) were 420.0 ± 0.1 parts per million (ppm), 2.3 ppm more than 2022 and 151% of the pre-industrial level (in 1750). 420 ppm corresponds to 3,276 Gt of $CO_2$ in the atmosphere.

Real-time data from specific locations show that levels of these three main greenhouse gases continued to increase in 2024.

### Global Mean Near-surface Temperature

In addition to 2024 setting a new record, each of the past ten years, 2015-2024, were individually the ten warmest years on record.

The record temperature in 2024 was boosted by a strong El Niño which peaked at the start of the year. In every month between June 2023 and December 2024, monthly average global temperatures exceeded all monthly records prior to 2023. Record levels of greenhouse gases were the primary driver, with the shift to El Niño playing a lesser role.

**Ocean Heat Content**

Around 90% of the energy trapped by greenhouse gases in the Earth system is stored in the ocean. In 2024, ocean heat content reached its highest level in the 65-year observational record. The rate of ocean warming over the past two decades, 2005-2024, is more than twice that in the period 1960-2005.

Ocean warming leads to degradation of marine ecosystems, biodiversity loss, and reduction of the ocean carbon sink. It fuels tropical storms and contributes to sea-level rise. It is irreversible on centennial to millennial time scales. Climate projections show that ocean warming will continue for at least the rest of the 21st century, even for low carbon emission scenarios.

**Ocean Acidification**

Acidification of the ocean surface is continuing, as shown by the steady decrease of global average ocean surface pH. The effects of ocean acidification on habitat area, biodiversity and ecosystems have already been clearly observed, and food production from shellfish aquaculture and fisheries has been hit as have coral reefs.

Projections show that ocean acidification will continue to increase in the 21st century, at rates dependent on future emissions. Changes in deep-ocean pH are irreversible on centennial to millennial time scales.

**Global Mean Sea Level**

In 2024, global mean sea level was the highest since the start of the satellite record in 1993 and the rate of increase from 2015-2024 was double that from 1993–2002, increasing from 2.1 mm per year to 4.7 mm per year.

Sea level rise has cascading damaging impacts on coastal ecosystems and infrastructure, with further impacts from flooding and saltwater contamination of groundwater.

**Glacier Mass Balance**

The period 2022-2024 represents the most negative three-year glacier mass balance on record. Exceptionally negative mass balances were experienced in Norway, Sweden, Svalbard, and the tropical Andes.

Glacier retreat increases short-term hazards, harms economies and ecosystems and long-term water security.

**Sea-ice Extent**

The 18 lowest Arctic sea-ice minimum extents in the satellite record all occurred in the past 18 years. The annual minimum and maximum of Antarctic sea-ice extent were each the 2nd lowest in the observed record from 1979.

The minimum daily extent of sea-ice in the Arctic in 2024 was 4.28 million km2. Antarctic sea-ice extent dropped below 2 million km2.

## 7. Trump Administration plans to gut Noaa

*Extracts from an article by Gabrielle Canon, Guardian website, 20 March 2025*

Operating 18 satellites and 15 research and survey ships, the National Oceanic and Atmospheric Administration (Noaa) is the pre-eminent climate research agency in the US. It provides essential climate and weather intel, serving the American public and acting as an international leader. The agency's scientists, engineers and policy experts issue forecasts relied on by aviation, agriculture and fishing industries. It advises on species protection and provides ocean floor mapping and increasingly precise modelling on what to expect as the climate crisis unfolds. And it is a primary resource for emergency managers and the public during extreme weather events and natural disasters when fast, accurate information matters most.

Despite this, and amid a flurry of legal challenges and domestic and global outcry, the Trump administration has continued with plans to gut Noaa. It is a crackdown on climate science that experts say will be felt across the US and around the world.

"Just about every component of the agency contributes to our understanding of the climate," said Craig McLean, the former director of Noaa research who served the agency for four decades before retiring in 2022. Hundreds of workers indiscriminately let go in recent weeks hang in limbo, their jobs paused while courts examine the legality of the Trump administration's sweeping firings. Meanwhile, the agency is bracing for the next rounds of cuts as leaders make moves to comply with Trump's "reduction in force", an order that will cull 1,029 more positions.

Vital work has slowed or stopped as teams try to navigate the chaos, along with the threat of severe budget cuts and political restrictions. Employees have been asked to compile databases of contracts and grants that contain references to environmental policy or particular key words, including "climate change", "diversity" and "environmental agreement", for further evaluation.

While the losses are expected to have a profound impact on the American public, the impact will be felt globally, too. Scientists and forecasters around the world depend on Noaa satellites, studies and intel, including data sharing that tracks severe weather across Europe, coordination for disaster response in the Caribbean, and monitoring deforestation and the effects of the climate crisis in the Amazon rainforest.

Already, the US has lost its position as a scientific leader after the president's withdrawal from international accords. The president also reportedly stopped government scientists and other US representatives from participating in Intergovernmental Panel on Climate Change meetings.

Among the 800 positions cut were workers who track El Niño/La Niña weather patterns around the world, people who model severe storm risks and scientists contributing to global understanding of what could happen as the world warms.

## 8.Climate crisis on track to destroy capitalism as we know it, warns top insurer

*Extracts from an article by Damian Carrington Guardian Environment editor, 3 Apr 2025*

The world is fast approaching temperature levels where insurers will no longer be able to offer cover for many climate risks, said Günther Thallinger, on the board of Allianz SE, one of the world's biggest insurance companies. He said that without insurance, which is already being pulled in some places, many other financial services become unviable, from mortgages to investments.

Global carbon emissions are still rising and current policies will result in a rise in global temperature between 2.2C and 3.4C above pre-industrial levels. The damage at 3C will be so great that governments will be unable to provide financial bailouts and it will be impossible to adapt to many climate impacts, said Thallinger, who is also the chair of the German company's investment board and was previously CEO of Allianz Investment Management.

The core business of the insurance industry is risk management and it has long taken the dangers of global heating very seriously. In recent reports, Aviva said extreme weather damages for the decade to 2023 hit $2tn, while GallagherRE said the figure was $400bn in 2024.

No governments will realistically be able to cover the damage when multiple high-cost events happen in rapid succession, as climate models predict, Thallinger said. Australia's disaster recovery spending has already increased sevenfold between 2017 and 2023, he noted.

The idea that billions of people can just adapt to worsening climate impacts is a "false comfort", he said: "There is no way to 'adapt' to temperatures beyond human tolerance … Whole cities built on flood plains cannot simply pick up and move uphill."

At 3C of global heating, climate damage cannot be insured against, covered by governments, or adapted to, Thallinger said: "That means no more mortgages, no new real estate development, no long-term investment, no financial stability. The financial sector as we know it ceases to function. And with it, capitalism as we know it ceases to be viable."

The only solution was to cut fossil fuel burning, or capture the emissions, he said, with everything else being a delay or distraction. He said capitalism must solve the crisis, starting with putting its sustainability goals on the same level as financial goals.

Ross Rutherford

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