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\* While Chemwatch has taken all efforts to ensure the accuracy of information in this publication, it is not intended to be comprehensive or to render advice. Websites rendered are subject to change.

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## **Regulatory Update**

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### **ASIA PACIFIC**

#### Safe Work Australia Research and Evaluation Strategy

#### 2025-06-11

The release of the Safe Work Australia Research and Evaluation Strategy signals a reinvigorated research and evaluation focus for the Agency and our drive for coordinated, collaborative national research to improve work health and safety outcomes and workers' compensation arrangements.

The research strategy:

- describes the research 'ecosystem' relating to improved work health and safety and workers compensation arrangements
- sets out its purpose, vision and goals
- outlines priority workstreams to achieve its goals
- identifies initial focus areas for research and evaluation, and
- describes guiding principles that will ensure our research leads to impactful, positive policy outcomes.

The research strategy will guide our collaboration and conversations with colleagues across the WHS and workers' compensation ecosystem to facilitate research that contributes to healthier, safer workplaces.

- Read the Research and Evaluation Strategy
- See the Research and Evaluation Strategy at a glance
- Watch the Strategy video message from Marie Boland, CEO of Safe Work Australia

#### Read More

Safe Work Australia, 11-06-25

https://www.safeworkaustralia.gov.au/data-and-research/research-andevaluation-strategy

### Update on Application Requirements for 'closely similar' **Item 6 and 7 Applications**

#### 2025-06-11

It is important that the Australian Pesticides and Veterinary Medicines Authority (APVMA) receives complete applications that meet the statutory criteria, as that assists us to be an efficient regulator.

# **Regulatory Update**

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To help ensure we receive the appropriate information in an application, the APVMA is releasing this update on application requirements for Item 6 and 7 Applications.

Applications to register a new chemical product sometimes rely on the new chemical product being closely similar to a reference chemical product. In these cases, the applicant asks the APVMA to consider the data on the nominated reference product, without requiring the submission of any (Item 7) or minimal (Item 6) further supporting technical data with their application.

The APVMA is clarifying expectations as to what data must be held by the nominated reference product to meet our application requirements.

This change will take effect immediately and will also apply to all Item 6 and 7 applications currently with the APVMA.

#### Read More

APVMA, 11-06-25

https://www.apvma.gov.au/news-and-publications/news/updateapplication-requirements-closely-similar-item-6-and-7-applications

#### Call for comment on use of a nutritive substance in infant formula

#### 2025-06-11

Food Standards Australia New Zealand (FSANZ) is calling for comment on an application to permit the use of a nutritive substance in infant formula products.

The substance, 3-fucosyllactose (3-FL), is a type of human-identical milk oligosaccharide (HiMO) made using a genetically modified source organism.

The application seeks approval to use the synthesised 3-FL in infant formula products. FSANZ has found it is chemically, structurally and functionally the same as the naturally occurring 3-FL found in human milk.

3-FL offers potential health benefits for infants including increasing beneficial gut bacteria, such as Bifidobacterium, and anti-pathogenic effects.





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## **Regulatory Update**

Our safety assessment found no public health or safety concerns with the proposed use. While breastfeeding is recommended, a safe and nutritious substitute for breast milk is needed for infants who are not breastfed.

All commercially produced infant formula products available in Australia must comply with the composition and safety requirements outlined in the Australia New Zealand Food Standards Code.

These standards apply in Australia only. The New Zealand Government is responsible for maintaining infant formula product regulations in New Zealand.

To have your say about this application, visit the FSANZ Consultation Hub. Submissions close at 11:59pm (Canberra time) Wednesday 23 July 2025.

#### Read More

ANZ Food Standards, 11-06-25

https://www.foodstandards.gov.au/media/call-comment-use-nutritivesubstance-infant-formula-0

### **AMERICA**

#### Harmful ultraprocessed foods may be removed from billions of California school lunches

#### 2025-06-04

Move over, MAHA. California has just overtaken President Donald Trump's "Make America Healthy Again" Commission in the guest to identify which ultraprocessed foods are the most harmful for human health.

Numerous studies have linked an additional serving a day of ultraprocessed foods, or UPFs, to a greater risk of developing or dying from dozens of adverse health outcomes, including cancer, heart disease, obesity, type 2 diabetes and various mental health conditions.

Which of the thousands of ultraprocessed foods on grocery shelves could be most responsible for such ill health? To date, answers are elusive. Research is in its infancy. Expert advocates and food manufacturers disagree on harms and definitions, while lobbyists battle behind the scenes.

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# **Regulatory Update**

#### Read More

IUN. 20, 2025

CNN, 04-06-25

https://edition.cnn.com/2025/06/03/health/ultraprocessed-californiafood-legislation-wellness

### Environment, social justice groups withdraw support for governor's key groundwater protection bill

2025-06-10

A 39-page amendment added to the bill Friday neutralizes the power it would have brought to state agencies to enforce pollution regulations, groups said

Groups that helped champion one of Gov. Tina Kotek's key groundwater protection bills this session are withdrawing their support and asking the Legislature to let it die for now, following a last-minute amendment they say effectively neutralizes the intent of the legislation.

Senate Bill 1154 as first proposed in February would provide long overdue updates to the state's Groundwater Quality Protection Act first passed in 1989, giving state agencies more authority to coordinate and to intervene early in Oregon's contaminated groundwater areas.

Since 1989, three critical groundwater management areas have been identified in Oregon. They are all still considered to be in critical condition due to nitrate contamination, almost entirely from agricultural fertilizers and animal manure, and none have seen vast improvement in the last two to three decades.

Groups heavily involved in addressing water contamination issues in northeast Oregon — including the nonprofits Oregon Rural Action, Center for Food Safety, Food & Water Watch, Columbia Riverkeeper, and Friends of Family Farmers — consulted with Kotek's environmental advisers on the bill and offered testimony supporting it in recent months.

#### Read More

Oregon Capital Chronicle, 10-06-25

https://oregoncapitalchronicle.com/2025/06/10/environment-socialjustice-groups-withdraw-support-for-governors-key-groundwaterprotection-bill/





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# **Regulatory Update**

### Chesapeake Bay health grade dips after hottest year on record and extreme rainfall patterns

#### 2025-06-10

The health of the Chesapeake Bay declined in an annual report card on the nation's largest estuary released Tuesday, with scientists noting the effect of extreme rainfall patterns during the hottest year on record.

The University of Maryland Center for Environmental Science gave the bay a C grade in its report card. That compares to a C-plus grade the bay received last year, which was the highest grade it had received since 2002.

"There was a substantial upturn in the overall Bay Health score in 2024, and it came down a little this year," said Heath Kelsey, director of UMCES Integration and Application Network. "Over the long term, though, there is still an improving trend from the 1980s until now. We think extreme weather may have had some impact on the scores this year."

The report noted that last year was the hottest year on record, with extreme rainfall patterns.

#### Read More

AP, 10-06-25

https://apnews.com/article/chesapeake-bay-report-environment-climate-832b631dbdb5c18f99682d0ffe74185a

### ACC Files TSCA Section 21 Petition Seeking **Reconsideration of TCE Risk Management Rule**

#### 2025-06-11

On May 27, 2025, the American Chemistry Council (ACC) petitioned the U.S. Environmental Protection Agency (EPA) under Section 21 of the Toxic Substances Control Act (TSCA) to reconsider the final risk management rule for trichloroethylene (TCE). ACC requests that EPA reconsider and amend two provisions of the rule:

Revise the byproduct exclusion in 40 C.F.R. Section 751.301(c) by removing the "site-limited" restriction that requires byproduct TCE to be reused as a "part of the same overall manufacturing process." The petition states that this would allow facilities to continue reusing/ processing byproduct TCE either at the same facility where the byproduct was generated or at another facility; and

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Delete the last sentence from the "regulatory threshold" provision in 40 C.F.R. Section 751.301(b), allowing facilities to continue discharging wastewater that contains TCE at less than 0.1 percent by weight pursuant to their valid, existing Clean Water Act (CWA) National Pollutant Discharge Elimination System (NPDES) permits.

#### Read More

B&C. 11-06-25

https://www.lawbc.com/acc-files-tsca-section-21-petition-seekingreconsideration-of-tce-risk-management-rule/

#### **HHS Announces Release of MAHA Report**

#### 2025-06-11

On May 22, 2025, the U.S. Department of Health and Human Services (HHS) announced the release of a new federal report, Making Our Children Healthy Again (MAHA Assessment) issued by the Make America Healthy Again (MAHA) Commission. The MAHA Commission was established by Executive Order (EO) 14212 to:

- 1. study the scope of the childhood chronic disease crisis and any potential contributing causes, including the American diet, absorption of toxic material, medical treatments, lifestyle, environmental factors, Government policies, food production techniques, electromagnetic radiation, and corporate influence or cronyism;
- 2. advise and assist the President on informing the American people regarding the childhood chronic disease crisis, using transparent and clear facts; and
- 3. provide to the President Government-wide recommendations on policy and strategy related to addressing the identified contributing causes of and ending the childhood chronic disease crisis. Read More

#### B&C, 11-06-25

https://www.lawbc.com/hhs-announces-release-of-maha-report/



# **Bulletin Board**

# **Regulatory Update**

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### **EUROPE**

# New breakthrough for monitoring microplastics to protect our health and the environment

#### 2025-06-06

Microplastics are inevitable in our daily lives. We inhale them. We ingest them. We drink them. From the depths of our oceans to mountain peaks, and increasingly within our own bodies, these tiny pieces of plastics are present all over our planet.

The JRC has now released a world-first reference material which will help improve analysis of microplastic particles in water. Microplastic pollution is a growing concern, with potentially negative impacts on human health and on our environment. To understand the scope of this problem, we need to be able to measure and map the extent of microplastics pollution.

Analysing these particles is a challenging task, as they vary significantly in size, shape, composition, and chemical structure, making it difficult to accurately assess their presence. Furthermore, different laboratories may use differently.

#### **Read More**

European Commission, 06-06-25

https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/ new-breakthrough-monitoring-microplastics-protect-our-health-andenvironment-2025-06-06\_en

# Commission launches strategy to enhance water security for people, economy and environment 2025-06-04

Today, the Commission adopted the European Water Resilience Strategy aiming at restoring and protecting the water cycle, securing clean and affordable water for all and creating a sustainable, resilient, smart and competitive water-economy in Europe.

This comprehensive strategy will support Member States in managing water more efficiently, both through implementation of current EU water legislation and through over 30 actions. Member States, regions and municipalities, but also citizens and businesses, are the key actors of water resilience.

# **Regulatory Update**

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Water is key to our existence, but today we can no longer take water for granted. Europe has been hit by extreme weather events, including catastrophic floods, prolonged droughts and forest fires. With rising climate change impacts, this will only get worse. No country or region is spared. This affects citizens, farmers, environment and businesses alike, with impacts on health, disruption of energy, food and drinking water supply, and growing economic losses across the EU. Five out of the top ten global risks for businesses are water related.

Today, water resilience and sustainable water management must be at the heart of our agenda to enhance EU security in line with climate scenarios and make our businesses more competitive and innovative, and Europe more attractive for investments It is an opportunity for European researchers and companies that are well-positioned to lead the way as they account for 40% of the patents for water technologies worldwide.

President Ursula von der Leyen said: "Water is life. Water resilience is key for our citizens, farmers, environment, and businesses. The Commission's Water Resilience Strategy charts a path toward a sustainable, resilient, smart, and competitive water-economy. We must act now to protect this scarce resource."

#### Read More

European Commission, 04-06-25

https://ec.europa.eu/commission/presscorner/detail/en/ip\_25\_1404

### **INTERNATIONAL**

#### Nations call for strong plastics treaty as difficult talks loom

#### 2025-06-10

More than 90 countries called on Tuesday for a global treaty to restrict plastic production, ahead of another round of hard-fought negotiations on the pact.

The talks collapsed in late 2024 with nations unable to agree on how to stop millions of tonnes of plastic waste from entering the environment each year.

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## **Regulatory Update**

Ahead of the next round of negotiations in August, ministers from 95 countries issued a symbolic call for a binding treaty that caps plastic production and phases out harmful chemicals.

"This declaration sends a clear and strong message: we will not give up," France's environment minister Agnes Pannier-Runacher said at the UN Ocean Conference in Nice in southern France, where the statement was issued.

"We must reduce our production and consumption of plastics."

So-called "high-ambition" nations have long pushed for the accord to include caps on the manufacture of new plastic, which is largely made from chemicals derived from fossil fuels.

An opposing group of "like-minded" countries -- mostly oil and petrochemical giants -- have rejected calls for production limits and pushed instead for a treaty that prioritises waste management.

Mexico's environment minister Alicia Barcena said caps on plastic were critical "to send a message on the root of the plastic crisis" and recycling and waste management alone would not solve the problem.

#### Read More

France24, 10-06-25

https://www.france24.com/en/live-news/20250610-nations-call-forstrong-plastics-treaty-as-difficult-talks-loom

#### How the circular economy can help beat plastic pollution

#### 2025-06-05

On this year's World Environment Day, observed on June 5th, the global community is uniting under the powerful theme: Beat Plastic Pollution. With plastic waste now found everywhere—from the deepest oceans to the human bloodstream—the time for urgent and coordinated action is now. For the waste management industry, this moment underscores its vital role in turning plastic waste into sustainability success through the principles of the circular economy.

Plastic pollution has become one of the most pervasive environmental threats of our time. Every year, between 19 and 23 million tonnes of plastic waste leak into aquatic ecosystems, while 13 million tonnes accumulate

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in soil, according to the United Nations Environment Programme (UNEP). The effects are not limited to environmental degradation; human health is increasingly at risk.

"Plastic does have a role to play in our societies. But the way we produce, use and discard many plastics has swamped the world in pollution," said Inger Andersen, Executive Director of UNEP, during the World Environment Day 2025 Commemoration Ceremony. "Microplastics are increasingly being found in the arteries, lungs, brains, placenta and breast milk of people-where they simply do not belong."

Andersen emphasized that the solution lies far beyond recycling: "Only adopting a circular approach across the full lifecycle will ensure that plastic pollution stays out of our oceans, our soils and our bodies. This means a complete rethink of how we design, make, use and reuse plastics."

#### Read More

Waste Management World, 05-06-25

https://waste-management-world.com/materials/how-the-circulareconomy-can-help-beat-plastic-pollution/





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## **REACH Update**

JUN. 20, 2025

#### **Drinking Water Directive Stakeholders Workshop** 2025-06-13

ECHA's hybrid workshop for DWD stakeholders brings together all those who are considering notifying to ECHA their intention to apply for adding, reviewing or removing starting substances, compositions or constituents from the Drinking Water Directive European positive list.

Key themes on the first (half) day of the event will include an introduction to the legal obligations and data requirements for DWD notifications of intention and DWD applications and the preparations that ECHA is making for the start of the notification of intention and application processes in early 2026 and early 2027 respectively. Presentations will also cover the IT tools and submission systems that ECHA has been setting up as well as guidance documents, IUCLID manuals and practical guides created to support the work of notifiers and applicants.

On the second (full) day, a series of demonstrations and live Q&A sessions will present the entire DWD notification of intention process: from the creation of an ECHA account, to the generation and validation of a IUCLID dossier, the submission of the IUCLID dossier to ECHA, the receipt of the submission outcome and the publication of the notification of intention on the ECHA Chemicals Database website (ECHA CHEM).

Whether attending online or in person, this workshop is an essential platform and key source of new information and resources for stakeholders interested in acting as DWD notifiers from 2026 onwards.

#### Read More

ECHA, 13-06-25

https://echa.europa.eu/-/2025-drinking-water-directive-stakeholdersworkshop

# **Janet's Corner**

CHEMWATCH

#### Who Am I?

2025-06-20

I am a colorless, odorless, and highly reactive gas, the most abundant element in the universe. I am a key component of water and all organic compounds. My fusion powers the sun and other stars, and I'm being explored as a clean energy source here on Earth. Who am I?

(Send in your answers and get a surprise Chemwatch merch from us for free)



I am a colorless, odorless, and highly reactive gas, the most abundant element in the universe.



# Bulletin Board

# **Hazard Alert**

#### **Barium**

#### 2025-06-20

Barium is a chemical element with symbol Ba and atomic number 56. It is a silvery-white metal that can be found in the environment, where it exists naturally. Because of its high chemical reactivity barium is never found in nature as a free element. It occurs combined with other chemicals, such as sulphur, carbon or oxygen. Barium is very light and its density is half that of iron. It oxidises in air, reacts vigorously with water to form the hydroxide, liberating hydrogen. Barium reacts with almost all the nonmetals, often forming poisonous compounds. This substance does not occur as a mineral, but can be prepared by heating barium carbonate.[1,2]

#### **USES** [2,3]

Barium is often used in barium-nickel alloys for spark-plug electrodes and in vacuum tubes as a drying and oxygen-removing agent. In addition, it is used in fluorescent lamps: impure barium sulphide phosphoresces after exposure to the light. Barium compounds are used by the oil and gas industries to make drilling mud. Drilling mud simplifies drilling through rocks by lubricating the drill. Furthermore, barium compounds are used to make paint, bricks, tiles, glass, and rubber. Barium nitrate and clorate give fireworks a green colour.

#### **EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]**

#### **Exposure Sources**

- The general population is exposed to barium through consumption of drinking water and food, usually at low levels.
- Exposure may also occur during x-ray diagnosis. Barium sulphate is frequently utilised as a benign, radiopaque aid to x-ray diagnosis in colorectal and some upper gastrointestinal examinations.
- Exposure to barium and compounds may also occur via contact with oil and gas drilling muds, automotive paints, stabilisers for plastics, case hardening steels, bricks, tiles, lubricating oils, and jet fuel as well as in various types of pesticides.
- Occupational exposure to barium primarily occurs in barium mining or processing industries.

#### **Routes of Exposure**

Inhalation – generally limited to occupational exposure.

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### UN. 20, 2025

- Oral Primary route of exposure for general population. Some foods, such as Brazil nuts, seaweed, fish, and certain plants, may contain high amounts of barium.
- Dermal minor route of exposure.

**Hazard Alert** 

#### **HEALTH EFFECTS** [4]

#### **Acute Health Effects**

Barium has been found to potentially cause gastrointestinal disturbances and muscular weakness when people are exposed to it at levels above the EPA drinking water standards for relatively short periods of time. Some people who eat or drink amounts of barium above background levels found in food and water for a short period may experience vomiting, abdominal cramps, diarrhoea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness. Eating or drinking very large amounts of barium compounds that easily dissolve can cause changes in heart rhythm or paralysis and possibly death.

#### **Carcinogenicity**

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have not classified barium as to its carcinogenicity. The EPA has determined that barium is not likely to be carcinogenic to humans following ingestion and that there is insufficient information to determine whether it will be carcinogenic to humans following inhalation exposure.

#### SAFETY

#### First Aid Measures [5]

- Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Warm water must be used. Get medical attention.
- Skin Contact: In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.



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## **Hazard Alert**

- Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

#### **Personal Protective Equipment [4]**

The following personal protective equipment is recommended when handling barium:

- Splash goggles;
- Lab coat:
- Dust respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Dust respirator;
- Boots;
- Gloves;
- A self-contained breathing apparatus should be used to avoid inhalation of the product.

Note: Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling.

#### REGULATION

#### **United States**

The following exposure limits are for Coal Tar Pitch Volatiles:

EPA has set a limit of 2.0 milligrams of barium per litre of drinking water (2.0 mg/L), which is the same as 2 ppm.

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# **Hazard Alert**

- Occupational Safety and Health Administration (OSHA) has set Permissible Exposure Limits (PELs) of 0.5 milligrams of soluble barium compounds per cubic metre of workplace air (0.5 mg/m3) for 8-hour shifts and 40-hour work weeks. The OSHA limits for barium sulphate dust are 15 mg/m3 of total dust and 5 mg/m3 for respirable fraction.
- The National Institute for Occupational Safety and Health (NIOSH) has set Recommended Exposure Limits (RELs) of 0.5 mg/m3 for soluble barium compounds. The NIOSH has set RELs of 10 mg/m3 (total dust) for barium sulphate and 5 mg/m3 (respirable fraction).

#### REFERENCES

1. http://en.wikipedia.org/wiki/Barium

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- 2. http://www.lenntech.com/periodic/elements/ba.htm
- 3. http://www.atsdr.cdc.gov/toxguides/toxguide-24.pdf
- 4. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=326&tid=57
- 5. http://www.sciencelab.com/msds.php?msdsId=9927090
- 6. http://www.safeworkaustralia.gov.au/sites/swa/search/results. aspx?k=sulphuryl fluoride&s=Swa





# etin Board

## Gossip

Exotic Material Magnetism Opens Path for Robust Quantum Computers

#### 2025-06-05

A research team from Chalmers University of Technology, Aalto University and the University of Helsinki has identified a new class of quantum material that uses magnetism to stabilise qubits. The material demonstrates robust topological excitations, offering a potential pathway to reducing the environmental sensitivity of quantum computing components.

The research is published in Physical Review Letters.

#### Topological materials as a route to stability

Quantum computers are designed to use guantum mechanical phenomena—such as superposition and entanglement—to perform calculations that may be beyond the reach of classical systems. However, current devices are highly vulnerable to external noise, including thermal fluctuations, magnetic fields and mechanical vibrations. These perturbations cause gubits, the fundamental units of quantum information, to lose coherence, limiting the computational power and scalability of quantum systems.

One of the leading strategies to address this challenge involves developing materials that naturally preserve guantum states through their topology. Topological materials can support exotic states of matter that are less susceptible to environmental disruption. In particular, quantum states known as topological excitations, which are protected by the material's structure rather than external conditions, offer improved stability.

The research team has now introduced a quantum material that exhibits such excitations. Unlike previous approaches, which relied on rare interactions such as spin-orbit coupling, the new method employs magnetic interactions to create and maintain these states. Magnetism is a more commonly available property across a broad class of materials, expanding the search space for suitable quantum computing components.

"This is a completely new type of exotic quantum material that can maintain its quantum properties when exposed to external disturbances. It can contribute to the development of quantum computers robust enough to tackle quantum calculations in practice," said Guangze Chen, a

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postdoctoral researcher in applied quantum physics at Chalmers and lead author of the study.

#### A shift away from spin-orbit coupling

CHEMWATCH

Traditional efforts in topological quantum computing have depended on materials where spin-orbit coupling plays a central role. This interaction links an electron's intrinsic spin to its motion around the nucleus, enabling the emergence of topological states. However, few materials exhibit strong spin-orbit coupling, and engineering them has proven difficult.

In contrast, the new study shows that magnetically driven interactions can be used to stabilise quantum states in a comparable way. This change in strategy allows researchers to examine a wider variety of candidate materials.

"The advantage of our method is that magnetism exists naturally in many materials. You can compare it to baking with everyday ingredients rather than using rare spices", explained Chen. "This means that we can now search for topological properties in a much broader spectrum of materials, including those that have previously been overlooked."

#### **Development of new computational tools**

To support this shift in methodology, the team has also developed a computational tool that can directly quantify the topological characteristics of candidate materials. The tool can directly calculate how strongly a material exhibits topological behaviour.

"Our hope is that this approach can help guide the discovery of many more exotic materials," said Chen. "Ultimately, this can lead to nextgeneration guantum computer platforms, built on materials that are naturally resistant to the kind of disturbances that plague current systems."

While the work represents a step forward in the materials science of quantum computing, the findings are currently limited to theoretical and laboratory-based studies. Further work is needed to translate these advances into functional quantum devices.

Technology Networks, 5 June 2025

https://technologynetworks.com

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## Gossip

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# Gossip

CHEMWATCH

mentions that both Dalton and William Henry had probably unwittingly produced the new compound from oil gas previously.)

When the centenary of Faraday's discovery was celebrated in 1925 at the Royal Institution, 2 much emphasis was afforded to its alleged link to the coal-tar dyes initiated with William Perkin's mauveine (aniline purple) in 1856, which were still burgeoning in the early 20th century. That, however, was a bit of a fix, for it wasn't until 1845 that benzene was discovered in coal tar itself - the black and unappealing residue from gas extraction from crude oil - by Charles Mansfield, working under the German chemist Wilhelm Hofmann.

And it wasn't until 1833 that this 1:1 aromatic compound of carbon and hydrogen became known as benzene. The name (initially benzin) was proposed by the German chemist Eilhard Mitscherlich, who distilled it from benzoic acid extracted from the aromatic resin gum benzoin - that name in turn being rooted in Arabic alchemy. Mansfield began to produce benzene by distillation of coal tar on an industrial scale in 1849; it was soon in demand as a solvent, in particular for the newly invented drycleaning process.

#### **Purple patch**

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It was an aromatic benzene derivative, aniline, that Hofmann's young student Perkin used in 1856 to try to synthesise guinine, and which left him with the wonderful purple dye. To set up industrial production, Perkin needed to synthesise aniline from benzene by nitration followed by reduction - such a two-step reaction was unprecedented on an industrial scale at the time.

All this meant that arguably Mansfield's isolation of benzene was more important to the chemical industry than was Faraday's. Either way, the British chemist Henry Roscoe averred in 1884 that benzene (which many then called benzole) 'has become of greatest importance to us in the production of the splendid colours which are known as the beautiful aniline dyes.'

That was the message of the celebration organised in 1890 by the German Chemical Society in Berlin, dubbed the Benzolfest, which was attended by Hofmann and other leading chemists as well as Kaiser Wilhelm II. The attendees were shown an image of the 'benzene tree', in which coal and coal tar at the root and trunk produced branches adorned with a riot of colours: aniline purple and blue, magenta, naphthol yellow and black, alizarine orange and cyanine.

#### Benzene's 200-year legacy of transformation

#### 2025-06-16

For many chemistry students, benzene is the Proustian madeleine. Nothing conjures up those hours in the organic chemistry lab trying desperately to crystallise your products more vividly than the almond whiff of benzene derivatives. However abstract the concept of aromaticity has become in chemistry today, it's clear enough where it began: in the heady scent of the kernel at the heart of the compounds first considered aromatic, the benzene ring.

It is 200 years since benzene was first identified by Michael Faraday as a component of oil.1 That hexagonal ring structure, deduced four decades later, is now one of chemistry's icons - perhaps the only molecular structure with brand recognition that rivals DNA's double helix.

But as with DNA, benzene's familiar shape has gathered a mixed legacy. Just as the double helix signifies both life and the manipulations of it in modern genetics, so benzene has been a poster child for both the bounty of the chemical industry and the toxic, carcinogenic and polluting nature of some of its products. Benzene transformed chemistry, and the consequences are complicated.

#### **Bi-carburet beginnings**

Although Faraday discovered it, he didn't name it. To him it was the 'bicarburet of hydrogen': a compound of carbon and hydrogen. His discovery paper, read to the Royal Society on 16 June 1825, is a reminder of his clear and sometimes delightfully congenial way of writing. Having become interested in the compounds in oil five years earlier, he says that 'since then I have endeavoured to lay hold of every opportunity for obtaining information on the subject.' Such an opportunity was presented when one Mr Gordon gave him a fluid ('oil gas') produced by compression of the volatile components of oil by the Portable Gas Company, one of the businesses nurtured by the birth of gas lighting.

Faraday fractionally distilled this substance and found that some distillates could be crystallised on cooling. One of these, he said, was a colourless transparent liquid smelling both of the original oil gas and of almonds. It was slightly soluble in water, and very soluble in ether and alcohol.

Faraday's analysis revealed it to be a compound of carbon and hydrogen in the ratio 2:1 (hence 'bi-carburet') – for he was using the old atomic weights of John Dalton, whereas later revisions adjusted the ratio to 1:1. (Faraday



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The tree rose 'into the clouds to where the eye cannot yet follow it,' Hofmann said. He claimed, rather hyperbolically (and to some degree self-servingly), that, thanks to the benzene ring, 'the number of organic compounds all at once increased to infinity' – and in the chemical industry, especially in Germany, 'no dearth of industrious workers' were 'busily striving to collect the harvest.' That harvest soon broadened to drugs and foodstuffs, like the saccharin and caffeine sold to the Coca Cola Company by an American coal-tar company set up in 1901 by the businessman John Francis Queeny, called Monsanto Chemical.

#### **Centenary celebrations**

There's a lesson in all this about scientific centenaries that we might do well to consider. They tend to be not just, or even primarily, celebrations of discovery, but have a pedagogical or economic agenda. In 1906 the Royal Institution hosted an event to commemorate the half-century since Perkin's discovery that was at least in part an advertising opportunity for the dye industry, with nationalistic overtones.

In his opening address the chemist Raphael Meldola, sporting a mauve tie, commented on the aptness of the venue 'in which Michael Faraday discovered the hydrocarbon benzene as we now call it'. German chemist Carl Duisberg, a board member of Bayer, crowed back that 'Germany has the natural privilege in the organic chemical industry and other nations should not envy her in this, but leave it to her'.

That solecism did not, however, explain why there were no German delegates at the Royal Institution centenary of Faraday's work 19 years later. Rather, Germany was then being treated as an international pariah after World War I. The event, at which Faraday's original specimen of benzene was displayed, was convened by chemist Henry Armstrong, an emeritus at Imperial College, and it asserted a link between Faraday and the chemical industry with a banner in which the benzene ring, with an 'F' at its centre, was surrounded by the rainbow of coal-tar and related hues.

In his opening address, the Royal Institution's president Alan Ian Percy, Duke of Northumberland, lamented how British chemists had seen these chemical technologies 'pass into foreign hands, and others secure the birth-right which belonged to us'. At the reception banquet Armstrong even alluded back to Duisberg's comment from 1906 and said 'Today I have my revenge.'

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#### Structural transformation

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It was that iconic six-membered ring which had prompted the 1890 Benzolfest, which marked the 25th anniversary of Friedrich August von Kekulé's announcement of the molecular structure. Kekulé's work had a deeper significance to organic chemistry than merely figuring out how the carbon atoms in benzene were satisfied with so few hydrogens (important though this was). He shifted the emphasis of the field from classification – as exemplified by Jöns Jacob Berzelius's notion of compound types united by shared 'residues' or radicals – to structure.

Building (without due acknowledgement) on the ideas of English chemist Edward Frankland, Kekulé secured the concept of valency and developed the idea of the carbon chain. (Allegedly this idea arrived during a reverie on a London bus, but that might merely have been the first of Kekulé's selfmythologising stories.)

When Kekulé first presented his solution to the benzene riddle – a chain with the ends joined – in an 1865 paper 'On the constitution of aromatic substances', it looked more like a string of sausages. It was his students who, the following year, first presented the structure as a hexagon, and the German chemist Adolph Claus depicted the geometric stick form in the same year. Hofmann made that representation popular, and in 1872 Kekulé pointed out that there were two possible arrangements of the alternating single and double bonds: two equivalent isomers, which he supposed interconverted in a dynamical equilibrium.

It later became clear that there is only one type of carbon–carbon bond in the molecule, which Linus Pauling, drawing inspiration from Werner Heisenberg's quantum mechanics (devised in the year of the Faraday centenary), explained in terms of a resonance between coexisting structures.

Claus, incidentally, was a former student of the German chemist Hermann Kolbe, who never accepted Kekulé's structure and clung to the old hierarchical radical picture; he despised Kekulé personally. Most others, however, recognised the transformational nature of the new structural theory.

In 1898 the British chemist Francis Japp, delivering the Kekulé Memorial Lecture in London, said of the 'benzene theory' that 'three-fourths of modern organic chemistry is directly or indirectly, the product of this theory'. It was arguably a fair judgement. As the late historian of chemistry

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Bill Brock has put it: 'The future of chemistry, as well as industry, after 1865 was ... to lie in structural chemistry at the sign of this hexagon.'

Chemistry World, 16 June 2025

https://chemistryworld.com

# This battery self-destructs: Biodegradable power inspired by 'Mission: Impossible'

#### 2025-06-07

Could electronics disintegrate into nothing in real life? Binghamton University Professor Seokheun "Sean" Choi has researched disposable "papertronics" over the past 20 years, but the hardest part about making so-called transient electronics is the battery.

"Transient electronics can be used for biomedical and environmental applications, but they must disintegrate in a biosafe manner," said Choi, a faculty member at the Thomas J. Watson College of Engineering and Applied Science's Department of Electrical and Computer Engineering.

"You don't want to have toxic residues inside your body. That type of device is called bioresorbable electronics. For transient or bioresorbable electronics, the key challenge is the power source -- but most power sources, like lithium-ion batteries, include toxic material."

Choi and his student research team took lessons from their previous research into biobatteries and applied that knowledge to a new idea: In a paper recently published in the journal Small, they show the potential of using probiotics -- live microorganisms that offer health benefits when ingested but are otherwise harmless to the environment or humans.

Maedeh Mohammadifar, PhD '20, a graduate of Choi's Bioelectronics and Microsystems Lab, developed the original dissolvable microbial fuel cell during her time as a Binghamton student.

"We used well-known electricity-producing bacteria, which is within biosafety level 1, so it is safe -- but we were not sure what would happen if these bacteria were released into nature," Choi said. "But whenever I made presentations at conferences, people would ask: 'So, you are using bacteria? Can we safely use that?"

Current PhD student Maryam Rezaie led the latest research using a premade blend of 15 probiotics.

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"It's well documented that probiotics are safe and biocompatible, but we were not sure if those probiotics have electricity-producing capability," Choi said. "There was a question, so she did a lot of experiments on that."

Early results proved unpromising, he added, but "we didn't give up. We engineered in an electrode surface that might be preferable to the bacteria, using polymer and some nanoparticles to hypothetically improve the electrocatalytic behavior of probiotics and give them a boost."

The modified electrode was porous and rough, which offered excellent conditions for bacteria to attach and grow, and that improved the microorganisms' electrogenic capability. Coating the dissolvable paper with a low pH-sensitive polymer -- meaning that it will work only in an acidic environment like a polluted area or the human digestive system -increased the voltage output and the duration that the battery operated.

Although they produced only a small amount of power, Choi looks at the experiments as a proof of concept for him and future students to build on.

"Other research must be done," he said. "We used probiotic blends, but I want to study individually which ones have the extra electric genes, and how synergistic interactions can improve the power generation. Also, in this research we developed in a single unit of a biobattery. I want to contact them in series or parallel to improve the power."

Science Daily, 7 June 2025

https://sciencedaily.com

# Efficient organic photoredox catalyst enables greener chemical production at room temperature

#### 2025-06-19

Colorado State University researchers have published a paper in Science that describes a new and more efficient light-based process for transforming fossil fuels into useful modern chemicals. In it, they report that their organic photoredox catalysis system is effective, even at room temperature. That advantage could lower energy demands around chemical manufacturing in a variety of instances and could also reduce associated pollution, among other benefits.

The work is led at CSU by professors Garret Miyake and Robert Paton from the Department of Chemistry and the Center for Sustainable Photoredox Catalysis (SuPRCat).

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The system—inspired by photosynthesis—uses visible light to gently alter the properties of chemical compounds. It does this by exposing them to two separate photons (light particles) to generate energy needed for the desired reactions. A single photon does not normally carry enough energy for these processes, said Miyake. By combining energy from two light particles, the team's system can perform super-reducing reactions chemical changes that require a lot of energy to break tough bonds or add electrons—easily.

Miyake said their system was tested on a group of chemical compounds called aromatic hydrocarbons-otherwise known as arenes. These compounds are usually resistant to change.

"This technology is the most efficient system currently available for reducing arenes—such as benzene in fossil fuels—for the production of chemicals needed for plastics and medicine," Miyake said. "Usually, generating these reactions is difficult and energy intensive because the original bonds are so strong."

The research continues work being done through the U.S. National Science Foundation Center for Sustainable Photoredox Catalysis at CSU. Miyake is the director of that multi-institution research effort to transform chemical synthesis processes across many uses.

Efficient organic photoredox catalyst enables greener chemical production at room temperature

Professor Garret Miyake working with a researcher. Credit: Colorado State University College of Natural Sciences

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Professor Robert Paton speaks to his research team. Credit: Colorado State University College of Natural Sciences

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Katharine Covert, program director for the NSF Centers for Chemical Innovation program, said photoredox catalysis has become indispensable for many industries.

"Photoredox catalysis has become indispensable for pharmaceutical development and other industries," said Covert. "Through the NSF Center for Sustainable Photoredox Catalysis, synthetic and computational chemists have teamed up to understand the fundamental chemical nature of how those catalysts function, and in so doing, found a new path that requires less heat and energy."

Miyake said researchers across the center are developing catalysis systems similar to the one described in this paper to support energy-efficient production of ammonia for fertilizers, the breakdown of PFAS forever chemicals, and the upcycling of plastics.

"We built an all-star team of chemists to address these challenges and make a more sustainable future for this world," Miyake said. "The world has a time clock that is expiring, and we must meet the urgent need for developing sustainable technologies before our current ways of doing things put us in a place that we can't recover from."



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CU Boulder Professor Niels Damrauer is also an author on the paper and a member of the center. Other CSU authors include Amreen Bains, Brandon Portela, Alexander Green, Anna Wolff and Ludovic Patin.

Phys Org, 19 June 2025

https://phys.org

### Thousands of sensors reveal 3D structure of earthquake-triggered sound waves

#### 2025-05-29

Earthquakes create ripple effects in Earth's upper atmosphere that can disrupt satellite communications and navigation systems we rely on. Nagoya University scientists and their collaborators have used Japan's extensive network of Global Navigation Satellite System (GNSS) receivers to create the first 3D images of atmospheric disturbances caused by the 2024 Noto Peninsula Earthquake. Their results show sound wave disturbance patterns in unique 3D detail and provide new insights into how earthquakes generate these waves. The results were published in the journal Earth, Planets and Space.

#### Mapping electron density in the ionosphere

With over 4,500 GNSS receivers spread across the country, Japan has one of the densest networks in the world. These receivers help with precise location tracking and can also detect changes in a region of the upper atmosphere called the ionosphere. A research team led by Dr. Weizheng Fu and Professor Yuichi Otsuka from Nagoya University's Institute for Space-Earth Environmental Research (ISEE) has captured the detailed 3D structure of electron density changes in the ionosphere after the 7.5 magnitude Noto Peninsula Earthquake that occurred on January 1, 2024, in Ishikawa Prefecture, Japan.

When satellite signals travel through the ionosphere, they slow down because the radio waves interact with electrically charged particles. By measuring how much the signals slow down, scientists can calculate how many electrons are in the signals' path and map the total electron content. Mapping these electrons allows them to effectively probe and monitor the state of the ionosphere.

About 10 minutes after the earthquake, the sound waves it generated traveled upward through the atmosphere and reached the ionosphere

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(60-1000 km above Earth). This created ripple disturbances similar to throwing a stone in a pond.

To build a 3D model of wave patterns, the researchers used a technique called "tomography" -- similar to how CT scans create 3D images of the human body. They collected data on electron numbers from thousands of receivers tracking signals from satellites at different angles. By tracking their 3D models at different times after the earthquake, they created a time series of how electron density changed.

#### Sound waves generated from entire fault lines, not single points

South of the epicenter, the researchers observed a tilted sound wave pattern that gradually became more vertical over time. When an earthquake creates sound waves that travel upward through the atmosphere, the upper parts of the waves move faster than the lower parts. This makes the wave front lean or tilt as it moves. Over time, the tilted pattern gradually straightens into a more vertical alignment.

The researchers produced the first detailed 3D visualization of how the tilt angle changes over time during a seismic event. They tracked how the tilted wave patterns gradually straightened in unprecedented detail. Previous models assumed all sound waves came from a single point at the earthquake's center. While this matched some of their observations, it could not explain the complex, uneven wave patterns they saw in their 3D images.

To understand this, they included data from multiple wave sources along the fault line in their model, assuming that some parts of the fault generated waves about 30 seconds after the initial rupture. The results better matched their real-world observations and showed that earthquakes do not create atmospheric waves from just one spot, but rather from multiple points along the entire fault as different sections rupture over time. This explains why the atmospheric disturbances observed, such as tilted waves, were more complex than previous simpler models had predicted.

"By including multiple distributed sources and time delays, our improved modeling provides a more accurate representation of how these waves propagate through the upper atmosphere," Professor Otsuka highlighted.

"Disturbances in the ionosphere can interfere with satellite communications and location accuracy. If we understand these patterns better, we could improve our ability to protect sensitive technologies



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during and after earthquakes and enhance early warning systems for similar natural events," Dr. Weizheng Fu, the lead author added.

Moving forward, the researchers are working on applying their model to other natural events such as volcanic eruptions, tsunamis, and severe weather events.

Science News, 29 May 2025

https://sciencenews.com

#### Edible, Biodegradable Food Packaging Made From Milk Protein

#### 2025-06-10

Milk protein and plant-derived cellulose can be electrospun into thin fibers for use in biodegradable (and edible) materials, a new study has shown.

Milk protein and cellulose derived from plants may be the next big thing in sustainability, thanks to a first-of-its-kind advancement made by researchers at Penn State.

Accomplished via electrospinning, which involves using a voltage to force a liquid solution into a cone shape that stretches and morphs into tiny fibers as the solution jets from an ejector, the team combined the milk protein casein with hydroxypropyl methylcellulose, a compound also known as hypromellose and derived from plant material, to create nanofibers 1,000 times thinner than a human hair. They then manipulated those fibers into mats that hold promise for a variety of products, like biodegradable — and even edible — food packaging.

"In a proof-of-concept study, we demonstrated the successful fabrication of stand-alone casein-rich electrospun mats," said team co-leader Federico Harte professor of food science in the College of Agricultural Sciences. "Protein-based electrospun nanofibers are highly sought after for their potential use in tissue engineering, biomedical applications such as wound dressings, and emerging roles in edible packaging, offering sustainable food preservation and safety solutions."

In the study, available online now and slated to publish in the September issue of the Journal of Colloid and Interface Science, the researchers reported that the combination of casein enriched with hypromellose was electrospinnable up to a cellulose-to-casein ratio of one to four. However, fibers with the fewest beads, which are thickened, irregular sections, and

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greatest surface area — making them most desirable for inclusion in mats — were spun from a solution with a cellulose-to-casein ratio of 1:12.

And, in a novel discovery, at 100% relative humidity, the fiber mats chemically reacted to moisture with ease, transforming into clear films that hold potential for food wrap, the researchers suggested.

"Casein has a long history of use as a material for both food and non-food uses," said team co-leader Gregory Ziegler, distinguished professor of food science, explaining that the protein can enhance food textures and nutritional values, as well being used in the production of glues, paints, paper coatings, cosmetics and pharmaceuticals. "This research adds to its utility by giving a new form: nanofibers."

This study was the latest in a series of published research involving the electrospinning of casein, Harte noted. Previously, this research group assessed the electrospinning of casein alone and casein combined with carrageenan, a food additive derived from red seaweed and primarily used as a thickener, stabilizer and emulsifier in various food products. However, the mats produced in those studies contained weak and brittle nanofibers.

In this study, the researchers tested the idea of supplementing casein with hypromellose, which they hypothesized could provide strength and flexibility to the protein. They were right.

"The idea here was to create mats based on casein, which is something that hasn't been done before," Harte said. "Our early efforts using casein alone clearly showed that we needed to improve the mechanical properties of the mats, and we eventually decided to add hypromellose because we thought that an interaction between casein and cellulose would optimize mechanical properties in these mats."

Harte added that future research will explore novel applications for the edible casein nanofibers such as food packaging and filtration.

The National Dairy Council–Dairy Management Inc. funded this research.

Technology Networks, 10 June 2025

https://technologynetworks.com

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# Chemical 'staples' help collagen resist unraveling and repair itself after being heated

#### 2025-06-19

Simon Fraser University (SFU) research is yielding new insights into one of the most perplexing properties of collagen. A paper in Proceedings of the National Academy of Sciences by physics professor Nancy Forde and postdoctoral researcher Alaa Al-Shaer describes key molecular features that help enable this notoriously unstable protein to maintain its structure.

Collagen makes up approximately 20% of the protein found in our bodies. It provides stability to our connective tissues such as tendon, bone, cartilage and skin, and forms a scaffold in which cells grow and thrive.

It is also a protein that has puzzled scientists for a long time. How can a molecule that is structurally unstable at body temperature play such an important role in helping to hold our bodies together?

Understanding this may be key to learning how we can better treat collagen-associated diseases such as brittle bone disease, Ehlers-Danlos Syndrome and diabetes.

Individual collagens are too small to be seen using conventional light microscopes, so Al-Shaer used a technique called atomic force microscopy (AFM) to capture images of collagen proteins at different temperatures. Forde explains that this technique allows researchers to "feel" objects much like reading Braille or a needle on a record.

When stable, collagen has a triple-helix structure with three strands twisted together like rope or yarn. At higher temperatures these threads unravel into random coils. Al-Shaer recorded hundreds of images to map this process of unraveling, and how in some cases the proteins were able to fold back together when cooled.

She found that amino acids present in collagen IV called cysteines can form bonds between individual strands that can "staple" them together. Where these staples exist, collagen IV resisted unraveling when heated and was more likely to repair itself as it cooled. Collagens without these bonds fell apart more easily and were not able to reassemble when cooled.

When she searched protein sequence databases for similar cysteines in other species, Al-Shaer found that this chemical staple is very common in collagen IV from other multicellular life forms, including some species that first evolved very long ago.

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"This indicates these cysteines have an important functional role," Forde explains, "since if they had mutated to something else and done just as good a job, we'd expect to see other amino acids at these positions."

"This study was the first time we have used AFM imaging to study the stability of collagen at different temperatures and map the folding and unfolding pathways. We think this is incredibly promising for answering future questions for the field," says Forde.

Forde notes that many previous studies on collagen stability have used short strands of synthetic peptides. "It is hard to know how well lessons learned in these small peptide studies translate into effects within the full-length collagen proteins, whose sequences are far more complex," she says. AFM can help verify or challenge those results.

Forde notes that multiple graduate and undergraduate students have helped to advance her lab's work on collagen, and her team is looking forward to further developing these techniques to answer many other questions.

"We would like to look at mutated or otherwise chemically altered collagens that are associated with disease and aging, in order to understand the mechanism of disease better," she says.

"And I want to continue working with amazing students in SFU's Faculty of Science to make these discoveries."

Phys Org, 19 June 2025

https://phys.org

### Natural Plant Extract Removes up to 90% of Microplastics From Water

#### 2025-06-18

The same sticky substances that make okra slimy and give fenugreek its gel-like texture could help clean our water in a big way. Scientists have discovered that these natural plant extracts are surprisingly good at trapping microplastics, tiny plastic particles that pollute oceans, rivers, and even our drinking water.

In fact, researchers found that extracts from okra and fenugreek can remove up to 90 percent of microplastics from ocean water, freshwater, and groundwater. These results were recently published in the journal ACS Omega.

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Rajani Srinivasan and her research team have been searching for safe, plant-based ways to remove pollutants from water. In earlier lab experiments, they tested extracts from okra, fenugreek, and tamarind. They found that these natural polymers grab onto microplastics, causing them to clump together and sink to the bottom, making it much easier to separate the plastics from the water.

Srinivasan spoke about successful demonstrations of the plant extracts in freshwater and ocean water at ACS Spring 2022, a meeting of the American Chemical Society. In this next stage of the research, they have optimized the process for okra and fenugreek extracts in various types of water.

To extract the sticky plant polymers, the team soaked sliced okra pods and blended fenugreek seeds in separate containers of water overnight. Then, researchers removed the dissolved extracts from each solution and dried them into powders. Analyses showed that the powdered extracts contained polysaccharides, which are natural polymers.

#### Lab Tests Show High Efficiency of Natural Powders

- Initial tests in pure water spiked with microplastics showed that:
- One gram of either powder in a quart (one liter) of water trapped microplastics the most effectively.
- Dried okra and fenugreek extracts removed 67% and 93%, respectively, of the plastic in an hour.
- A mixture of equal parts okra and fenugreek powder reached maximum removal efficiency (70%) within 30 minutes.
- The natural polymers performed significantly better than the synthetic, commercially available polyacrylamide polymer used in wastewater treatment.

Then the researchers tested the plant extracts on real microplasticpolluted water. They collected samples from waterbodies around Texas and brought them to the lab. The plant extract removal efficiency changed depending on the original water source: Okra worked best in ocean water (80%), fenugreek in groundwater (80-90%), and the 1:1 combination of okra and fenugreek in freshwater (77%). The researchers hypothesize that the natural polymers had different efficiencies because each water sample had different types, sizes, and shapes of microplastics.

Polyacrylamide is currently used to remove contaminants during wastewater treatment, but the researchers say that okra and fenugreek extracts could serve as biodegradable and nontoxic alternatives.

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"Utilizing these plant-based extracts in water treatment will remove microplastics and other pollutants without introducing additional toxic substances to the treated water," says Srinivasan, "thus reducing long-term health risks to the population."

Sci Tech Daily, 18 June 2025

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https://scitechdaily.com

### Chemists leap across terpenoid landscapes with enzyme-enabled scaffold hopping

#### 2025-06-16

A research team led by Rice University has introduced an innovative strategy that uses enzymes to convert one terpenoid structure into many different forms, streamlining synthetic pathways and redefining the approach to natural product synthesis.

For decades, organic chemists believed that each natural product scaffold required a custom synthesis. However, this assumption has been challenged by a study led by Hans Renata, associate professor of chemistry at Rice, and published in Nature Chemistry June 16. The research team developed a method that transforms a single compound, sclareolide, into multiple structurally diverse terpenoids through enzymatic oxidation and chemical reorganization.

"We thought, 'What if the enzymatic step could be more than just a means to an end? What if it could unlock a whole new map of chemical space?" Renata said.

This change in mindset allowed the researchers to move from a singular scaffold to several, significantly enhancing synthetic efficiency.

#### From one scaffold, many paths

The researchers began with sclareolide, a commercially available sesquiterpene lactone derived from plants and traditionally used in the fragrance industry. This compound served as the foundation for a strategy that combined enzymatic and chemical transformations.

The research team selectively oxidized the molecule's third carbon atom using engineered cytochrome enzymes, which are large heme-containing proteins essential for metabolizing drugs and foreign substances. This transformation was previously unattainable through purely chemical means, Renata said.



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The resulting alcohol acted as a versatile platform for further chemical modifications. The approach diverges from conventional scaffold-focused methods, allowing for chemical transformations in molecules through nonbiological processes. This flexibility enabled the creation of entirely new molecular architectures without strictly following biosynthetic pathways.

Using this scaffold-hopping strategy, the research team successfully synthesized four distinct terpenoid natural products: merosterolic acid B, cochlioquinone B, (+)-daucene and dolasta-1(15),8-diene. Each product features a unique carbon framework derived from the same oxidized sclareolide intermediate.

#### **Rewriting retrosynthesis playbooks**

The researchers' strategy challenges traditional retrosynthetic logic, which typically advocates for a tailored approach for each new molecular target. Instead, this method suggests a shared entry point with branching pathways, significantly improving the efficiency and flexibility of synthetic design.

"We're no longer starting from scratch for each new scaffold," Renata said. "We're leveraging enzyme-enabled transformations to access new structures in fewer steps and with greater precision."

By enhancing the selectivity and reactivity of cytochrome enzymes, the researchers have broadened the possibilities for modifying complex molecules, leading to applications in medicinal chemistry and drug development down the line.

Moreover, the ability to produce multiple products from a common precursor saves time and costs while providing a framework for exploring the vast chemical space of bioactive compounds with greater efficiency, Renata said.

"Our work illustrates how a single enzymatic oxidation can serve as a nexus for molecular diversity," he said. "It's a concept that could transform how we think about synthesis."

The study was co-authored by Rice graduate student Junhong Yang and former postdoctoral associate Heping Deng as well as Fuzhuo Li from Fudan University and Jian Li from Shanghai Jiao Tong University.

Phys Org, 16 June 2025

https://phys.org

## Gossip

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#### From food to textile—agricultural waste could become the clothes of the future

#### 2025-06-17

Cellulose-based textile material can make the clothing sector more sustainable. Currently, cellulose-based textiles are mainly made from wood, but a study headed by researchers from Chalmers University of Technology points to the possibility of using agricultural waste from wheat and oat.

The method is easier and requires fewer chemicals than manufacturing forest-based cellulose, and can enhance the value of waste products from agriculture.

Making clothing from water-intensive cotton has a major impact on the climate. That's why cellulose from other raw materials has come into focus in recent years as a more resource-smart method of textile production.

Up to now, efforts have concentrated on wood-based cellulose. But in a study published in RSC Sustainability, researchers investigated a different path for cellulose fiber manufacture, by using waste products from agriculture, which Sweden has a lot of.

The researchers tested oat husks, wheat straw, potato pulp and sugar beet pulp. Oat husks and wheat straw turned out to work best to develop a pulp, called dissolving pulp, which is used to make clothing.

"With this method, which we further developed in this study, we show that you can make textile pulp from certain agricultural waste products," says Diana Bernin, Assistant Professor at the Department of Chemistry and Chemical Engineering at Chalmers and senior researcher in the study.

"This is an important step towards being able to create textiles from waste products instead of using cotton, which isn't climate-friendly, or wood, a material that we want to use for so many things while also needing to preserve it for the benefit of the climate."

#### More sustainable manufacturing with lye

The team used soda pulping as one part of the process. This means that the raw material is boiled in lye, which makes manufacturing more sustainable.

"Lye doesn't contain any toxins or substances that impact nature," she explains. "Soda pulping doesn't work for wood fibers, so making textile



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pulp from wheat straw and oat husks requires fewer chemicals than making forest-based cellulose. It's also a simpler procedure, in part because it doesn't require processing such as chipping and debarking.

"In addition, it increases the economic value of oats and wheat, when leftovers from their production can be used as raw materials for cellulose extraction."

Bernin says it is likely that several other agricultural waste products can be used for textile manufacture using the method her team developed. She is currently involved in an international project that has found, using the method in this study, that press-cake from grass from fields works very well to create dissolving pulp.

In continued studies that have yet to be published, the researchers have also taken another step towards practical application of the dissolving pulps, creating textile fibers based on pulp from wheat and the press-cake from grass.

#### Hope of using existing industries

In the long run, she sees good opportunities to use the pulp-and-paper industry, which already has technology and processes in place, to dissolve pulp from agricultural waste.

"If we can make use of our existing industry and adjust their processes instead of building new production facilities, we've already come a long way," she says.

The lead author of the study is Joanna Wojtasz, former postdoc at Chalmers and now a researcher at the innovation company Tree To Textile, which is one of the partners in the project.

"The study shows that there is a lot of potential in agricultural waste," Wojtasz says. "We really shouldn't disregard the opportunity to use this type of cellulose streams for our future clothing."

Phys Org, 2025-06-17

https://phys.org

## **Curiosities**

CHEMWATCH

Successful synthesis of neutral N<sub>6</sub> opens door for future energy storage

#### 2025-06-18

Nitrogen finally joins the elite tier of elements like carbon that can form neutral allotropes—different structural forms of a single chemical element. Researchers from Justus Liebig University, Giessen, Germany, have synthesized neutral hexanitrogen (N6)—the first neutral allotrope of nitrogen since the discovery of naturally occurring dinitrogen (N2) in the 18th century that is cryogenically stable and can be prepared at room temperature.

This new study, published in Nature, synthesized hexanitrogen (N6) via gas-phase reaction, with the main ingredients being chlorine (Cl2) or bromine (Br2) and an extremely reactive and explosive solid silver azide (AgN3), under reduced pressure.

The researchers spread AgN3 on the inner surface, and a gaseous halogen (Cl2 or Br2) was passed through the solid under reduced pressure at room temperature. The reaction triggered by the process produced N6 alongside byproducts chloronitrene (CIN) and hydrazoic acid (HN3).

These molecules were then trapped in argon matrices—an inert matrix of solid argon—at cryogenic conditions (10 Kelvin) to stabilize and isolate the highly reactive N6.

Molecular forms of nitrogen are highly promising as carbon-neutral and high-energy-density materials. Upon decomposition, they release a large amount of energy as they break down into their stable N2 form, a nontoxic, inert gas, unlike conventional fuels that produce greenhouse gases such as CO2.

Unfortunately, N2 is the only naturally occurring allotrope (molecular form) of nitrogen, which, due to its inert nature arising from exceptionally strong triple bonds, is unsuitable for use as a fuel.

For decades, scientists have tried synthesizing larger neutral nitrogen molecules as energy materials but failed due to the extremely unstable nature of polynitrogen molecules.

Previous studies have detected the azide radical (-N3) and the second N4 via spectroscopy, but their structure remained a mystery. On the theoretical front, the structures of N4 to N12 have been predicted, yet none have been experimentally isolated, as they are considered too unstable.



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This study broke the trend by not only successfully synthesizing the neutral N6 molecule but also identifying its linear, acyclic structure with C2h symmetry. The molecule consists of a chain of six nitrogen atoms where two azide (N3) units and three nitrogen atoms are held together by double bonds joined by a single N–N bond in the center.

The mechanism likely involved a two-step gas-phase reaction. At first, the gaseous Cl2 or Br2 reacted with silver azide to produce silver halide (AgX, where X = Cl or Br) and halogen azide (XN3). The halogen azide formed in the first step reacted with another molecule of silver azide to produce silver halide and hexanitrogen (N6).

The N6 produced at room temperature remained stable at cryogenic temperatures, allowing the researchers to isolate it as a pure film at 77 K—the temperature at which nitrogen turns liquid. Computational calculations revealed that the molecule had a half-life of 35.7 milliseconds at room temperature and over 132 years at cryogenic conditions.

The researchers also discovered that N6, upon decomposition, releases an exceptional amount of energy-2.2 times more per unit mass than the known explosive TNT and twice that of RDX.

They emphasize that the preparation of a metastable molecular nitrogen allotrope beyond N2 not only advances fundamental scientific understanding but also holds potential for future energy storage applications.

Phys Org, 18 June 2025

https://phys.org

#### Low-calorie sweetener could increase your risk of stroke 2025-06-15

If you're trying to avoid sugar in your diet, you'll want to be careful about how you choose and use your artificial sweeteners. A study led by physiologists from the University of Colorado Boulder shows that a popular sugar substitute called erythritol could increase your risk of suffering a stroke.

That's a bummer because erythritol has practically zero calories, works well as an ingredient for keto baking recipes, and is relatively affordable and easily available. It was approved by the FDA as a food additive back in 2001, so it's been around for over a couple of decades now.

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So what's this about an increased risk of stroke? The researchers wanted to closely examine how erythritol affects the functioning of blood vessels at the cellular level - specifically, brain microvascular endothelial cells, found in small blood vessels in the brain that regulate blood flow and prevent clots.

The team's in vitro model involved growing these cells and exposing them for three hours to a dose of erythritol equivalent to 30 g – the amount you'd find in a typical sweetened beverage. The results were concerning, to say the least.

Erythritol caused four key effects in the endothelial cells:

- An increase in oxidative stress, which signals damage to the cells.
- Reduced production of nitric oxide, which enables normal blood flow.
- Greater production of a blood vessel-constricting peptide.
- Impairment in the release of an enzyme responsible for dissolving blood clots.

These changes all point to a higher chance of ischemic stroke, and potentially greater severity of the condition too.

This is the latest in a growing body of evidence that erythritol may not be the best option for replacing sugar in your pantry. A major 2023 study linked the sweetener to a greater risk of heart attack and stroke; another from 2024 found it may "acutely stimulate a direct clot-forming effect," with participants exhibiting more proteins responsible for platelet clumping in their bloodstream.

So, yeah, things are looking bad for erythritol. It's also often added to monk fruit sweetener, which means even if you're making a better choice, you could still be putting yourself at risk.

It's worth noting that this study was conducted in a single instance in vitro, so it may not accurately depict how the sweetener might affect the blood vessel cells in living persons with different health factors and consumption habits. The results were published last week in the Journal of Applied Physiology.

Lead researcher Auburn Berry echoed the conclusions from previous studies. "While erythritol is widely used in sugar-free products marketed as healthier alternatives, more research is needed to fully understand its impact on vascular health," he said. "In general, people should be conscious of the amount of erythritol they are consuming on a daily basis."



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Source: American Physiological Society via PsyPost

New Atlas, 15 June 2025

https://newatlas.com

# Portable device detects poisonous pigment in books 2025-06-17

Librarians and physicists at the University of St Andrews in the UK have developed a portable device that can quickly and cheaply detect the presence of toxic pigments in Victorian-era book bindings.

The researchers developed the detector to identify a bright green pigment known as emerald green that may contain arsenic. Frequent handling of contaminated books can lead to health issues like eye, nose and throat irritation, and potentially more serious medical effects.

'The project began with the need to positively identify emerald green bindings in the University of St Andrews collections, using the analytical techniques available to us within the university,' explained Pilar Gil, who led the research. The 'Eureka moment' was discovering the unique reflectance pattern from emerald green pigment, he added.

Graham Bruce, senior research laboratory manager at St Andrews and one of the two physicists who developed this handheld screening tool, was tapped to help develop the new device because of his previous applied spectroscopy work, mainly to identify counterfeit whiskeys.

In this case they were looking for a compound – copper acetoarsenite – that was widely used in the 19th century but only recently discovered to also have been used in book bindings. Unfortunately, this pigment is particularly friable, so crumbles easily releasing arsenic into the air.

'Over the last year or so we've developed this very small tool which measures the key parts of the spectrum that we need to identify this compound,' Bruce tells Chemistry World. 'Not all green books of the correct time period contain this compound ... and what our tool does is to combine information from the visible part of the spectrum and the infrared part of the spectrum so that we can determine whether this pigment is present in the book binding or not.'

The advantage of this new screening device, he says, is that it can be pointed at a book and a green or red light displays within a fraction of a second to indicate whether or not the book contains this pigment.

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Besides being fast and easy to use, the instrument is also non-destructive. 'Because it's light, and relatively low intensities of light, it doesn't cause any additional breakdown of the materials in the book,' Bruce explains.'If you want to do something like x-ray fluorescence, that usually involves removing a part of the material that you want to interrogate.'

Pigment contamination concerns have recently caused libraries across the world to cut off access to portions of their book collections, pending specialised, costly and time-consuming testing. Last year, the French National Library reportedly removed four 19th-century books from public access after tests indicated that their covers and bindings contained emerald green. According to Bruce, the University of Bielefeld and several other German universities isolated approximately 60,000 books, pending toxicity testing.

Also in 2024, chemists at Lipscomb University in the US pulled more than two dozen of the school's Victorian-era books from circulation after tests revealed that they contained dyes with potentially dangerous levels of lead and chromium. They sealed the books and instructed librarians to use gloves and heavy-duty masks if working in a confined space with these materials.

At that time, the Lipscomb team was interested in exploring the use of portable x-ray fluorescence to establish a standardised analytical protocol to test potentially toxic book covers.

Chemistry World, 17 June 2025

https://website

#### Green chemistry research yields a safer method for synthesizing fluoride complexes 2025-06-18

Chemical synthesis lies at the heart of modern science and technology, enabling the creation of various pharmaceuticals, agrochemicals, and functional materials. While the demand for chemical synthesis grows with scientific advancements, it comes with the costs of environmental pollution and hazardous waste. To combat the same, researchers are now turning towards sustainable alternatives using green chemistry approaches.

One such chemical process which is in urgent need for greener alternatives is fluorination. Fluorine-based organic compounds find

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applications in a variety of industries, ranging from pharmaceuticals to electronics. These compounds are synthesized through the process of fluorination using different fluorinating agents like potassium fluoride (KF) and quaternary ammonium fluorides like tetrabutylammonium fluoride (Bu4NF).

While these reagents are promising, their reactivity is often hindered due to low solubility (as in the case of KF) and high hygroscopicity (seen in Bu4NF). This calls for the development of novel fluorinating agents with suitable properties and better reactivity.

Against this backdrop, a team of researchers led by Professor Toshiki Tajima from Shibaura Institute of Technology, Japan, came up with an exciting solution. The team developed a new fluorinating quaternary ammonium complex by combining KF with tetrabutylammonium bromide (Bu4NBr). The newly formed quaternary ammonium tri(1,1,1,3,3,3hexafluoroisopropanol)-coordinated fluoride (Bu4NF(HFIP)3) showed extremely low hygroscopicity and was found to be an excellent fluorinating reagent for electrochemical fluorination. The findings are published in Chemical Communications.

"KF is a safe, affordable fluorinating agent, but its poor solubility in organic solvents has limited its use. We had been exploring ways to make it more effective," explains Prof. Tajima. "It all clicked only after we discovered it readily dissolves in HFIP."

To develop the fluorinating complex, the team started by dissolving KF in HFIP and Bu4NBr in dichloromethane, respectively. Once dissolved, both solutions were mixed together for 30 minutes and were then subjected to filtration and purification.

The resultant product was a viscous and clear liquid of Bu4NF(HFIP)3. The chemical composition of the product was confirmed through NMR spectroscopy studies. Furthermore, the approach was also applied to other quaternary ammonium bromides for the synthesis of different reagents.

The resultant products showed low hygroscopicity, which is favorable for a greater shelf life. Additionally, the synthesis only involved a basic ion exchange reaction using KF, which makes the method simpler and inexpensive. Moreover, the method is also safer compared to other synthesis methods, making it a greener alternative for fluorination.

"The new fluorinating agent we developed in this study can have a range of applications in the synthesis of pharmaceuticals, agrochemicals,

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functional materials, molecular probes for PET inspection, and many more," remarks Prof. Tajima.

Many industries use fluorinating agents for the synthesis of organofluorine compounds. Having a safer fluorinating reagent that is easier to handle could be a game-changer and is a significant milestone in the field of green chemistry.

By overcoming the limitations of two different fluorinating reagents to form a novel fluorinating agent, the research has bridged a critical gap in the process of fluorination, opening avenues for sustainable and effective synthesis strategies.

Phys Org, 18 June 2025

https://phys.org

### Researchers Design New 2D Lattice to Extend Zinc-Ion Battery Lifespan

2025-06-17

The new superlattice helps support the stability of the cathode, resulting in a 50% extension to the number of cycles the battery can complete.

Scientists from the National Graphene Institute at The University of Manchester and the University of Technology Sydney have developed a new way to improve the lifespan of zinc-ion batteries, offering a safer and more sustainable option for energy storage.

The team designed a two-dimensional (2D) manganese-oxide/graphene superlattice that triggers a unique lattice-wide strain mechanism. This approach significantly boosts the structural stability of the battery's cathode material, enabling it to operate reliably over 5,000 charge-discharge cycles. That's around 50% longer than current zinc-ion batteries.

The research, published in Nature Communications, offers a practical route to scalable, water-based energy storage technologies.

#### Atomic-level control over battery durability

The breakthrough centres on a phenomenon called the Cooperative Jahn-Teller Effect (CJTE). A coordinated lattice distortion caused by a specific 1:1 ratio of manganese ions (Mn<sup>3</sup> and Mn<sup>4</sup>). When built into a layered 2D structure on graphene, this ratio produces long-range, uniform strain across the material.



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That strain helps the cathode resist breakdown during repeated cycling.

The result is a low-cost, aqueous zinc-ion battery that performs with greater durability, and without the safety risks linked to lithium-ion cells.

"This work demonstrates how 2D material heterostructures can be engineered for scalable applications," said Prof Guoxiu Wang, lead and corresponding author from University of Technology Sydney and a Royal Society Wolfson visiting Fellow at The University of Manchester. "Our approach shows that superlattice design is not just a lab-scale novelty, but a viable route to improving real-world devices such as rechargeable batteries. It highlights how 2D material innovation can be translated into practical technologies."

#### Towards better grid-scale storage

Zinc-ion batteries are widely viewed as a promising candidate for stationary storage, storing renewable energy for homes, businesses or the power grid. But until now, their limited lifespan has restricted real-world use.

This study shows how chemical control at the atomic level can overcome that barrier.

Co-corresponding author Prof Rahul Nair from The University of Manchester said, "Our research opens a new frontier in strain engineering for 2D materials. By inducing the cooperative Jahn-Teller effect, we've shown that it's possible to fine-tune the magnetic, mechanical, and optical properties of materials in ways that were previously not feasible."

The team also demonstrated that their synthesis process works at scale using water-based methods, without toxic solvents or extreme temperatures - a step forward in making zinc-ion batteries more practical for manufacturing.

Technology Networks, 17 June 2025

https://technologynetworks.com

#### Clean energy, dirty secrets: Inside the corruption plaguing california's solar market 2025-06-11

Solar power is growing by leaps and bounds in the United States, propelled by climate mitigation policies and carbon-free energy goals

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-- and California is leading the way as the nation's top producer of solar electricity. A new study in Energy Strategy Reviews has revealed a dark side to the state's breakneck pace for solar investment, deployment, and adoption, taking a first-time look at patterns of public and private sector corruption in the California solar market.

Researchers at the Boston University Institute for Global Sustainability (IGS) have identified seven distinct types of corruption abuses and risks in California solar energy. Among them, favoritism in project approvals, including a high-profile incident at the senior ranks of the U.S. Department of the Interior involving an intimate relationship with a solar company lobbyist. To fully realize a just energy transition, the authors call for major solar reforms in California as the U.S. increasingly relies on solar energy to decarbonize its electricity sector.

"It's a wake-up call that the solar industry cannot continue on its current trajectory of bad governance and bad behavior."

"In this groundbreaking study, we find that efforts to accelerate solar infrastructure deployment in California end up contributing to a sobering array of corruption practices and risks. These include shocking abuses of power in the approval and licensing phases as well as the displacement of Indigenous groups, and also nefarious patterns of tax evasion or the falsification of information about solar projects," says lead author Benjamin Sovacool, who is the director of IGS and a Boston University professor of earth and environment. "It's a wake-up call that the solar industry cannot continue on its current trajectory of bad governance and bad behavior."

Drawing on a literature review and original interviews and fieldwork, the study's authors arrive at a framework that helps explore the wider socio-political realities driving corruption at a time of explosive growth in the California solar market, from 2010 to 2024. During this period, the state's solar energy production increased exponentially, reaching 79,544 gigawatt hours in 2024, or enough to power approximately 7.4 million U.S. households for a year, according to the State of Renewable Energy dashboard.

The research implicates solar energy in numerous corruption practices and risks that have adversely affected communities, policymaking and regulation, and siting decisions and planning.

"The most eye-opening finding for me is how common corruption is at every level of solar development, from small-scale vendors to high-level

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government officials, even in a well-regulated, progressive state like California," says co-author Alexander Dunlap, an IGS research fellow.

#### Favoritism and other forms of corruption

To understand how corruption undermines the solar market, the researchers focused on numerous utility-scale deployments in Riverside County, the fourth most populous county in California. They set out to document patterns of perceived corruption from a broad range of voices, gaining insights through organized focus groups and observation at different solar sites, as well as conducting interviews door-to-door and in a local supermarket parking lot. Respondents included residents in Blythe and Desert Center, California, impacted by solar energy development, solar construction workers, non-governmental organizations, solar company employees, federal agencies, and state and local governments.

While the study's authors acknowledge the difficulty of confirming individual claims of corruption, their mixed-methods research approach combines these personal assertions with analysis of news stories, court testimony, and other official sources to support their findings.

They point to a blend of public, private, social, and political patterns of corruption in the California solar energy market.

- 1. Clientelism and favoritism: Hiring friends or family over others for solar projects and unfairly allocating government contracts or permits to project developers, which in one instance led to an investigative report questioning the influence of a sexual relationship.
- 2. Rent-seeking and land grabbing: Redirecting public funds or lands to benefit private developers and taking communal or public land from Indigenous peoples or other groups for energy infrastructure siting.
- 3. Service diversion: Withholding local benefits, such as lower electricity bills, or distributing locally generated power only to higher-paying parts of the state.
- 4. Theft: Forceful removal of flora or cultural artifacts, or disturbing animal habitat, to build solar project sites.
- 5. Greenwashing: Misleading the public about a solar project's environmental benefits; using flawed environmental or cultural impact assessments to evaluate project impacts, such as pollution of nearby waterways; and overriding environmental protections to fast-track solar infrastructure expansion.

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- 6. Tax evasion and avoidance: Not paying or underpaying taxes, or governmental authorities strategically failing to adequately allocate project funds to communities impacted by solar project development.
- 7. Non-transparency: Hiding, manipulating, or failing to disclose relevant or important information surrounding solar projects, such as the local economic benefits and environmental impacts.

#### A sunnier future?

Outside of a few headline-making scandals, corruption in California's renewable energy sector has gone largely unexamined, allowing the underlying dynamics at play to erode the potential of a just energy transition. To remedy this, the study's authors recommend corruption risk mapping to document problematic practices and entities, subsidy registers and sunset clauses to deter rent-seeking and tax evasion, transparency initiatives aimed at environmental changes and data production (for Environmental Impact Assessment), strong enforcement of anti-corruption laws, and shared ownership models for solar to improve accountability.

This newly published study, "Sex for Solar? Examining Patterns of Public and Private Sector Corruption within the Booming California Solar Energy Market," is part of a larger IGS research project looking at injustices in U.S. solar and wind energy supply chains.

Science Daily, 11 June 2025

https://sciencedaily.com

#### Supercomputer simulations show how to speed up chemical reaction rates at air-water interface 2025-06-18

Using the now-decommissioned Summit supercomputer, researchers at the Department of Energy's Oak Ridge National Laboratory ran the largest and most accurate molecular dynamics simulations yet of the interface between water and air during a chemical reaction. The simulations have uncovered how water controls such chemical reactions by dynamically coupling with the molecules involved in the process.

This new understanding of water's role could help researchers develop methods to accelerate chemical reactions at the interface, potentially increasing their efficiency and productivity for industrial processes.

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Specifically, the team from ORNL's Chemical Sciences Division investigated a bimolecular nucleophilic substitution reaction, known as SN2.

SN2 is one of the most common mechanisms in chemical, physical, biological and atmospheric chemistry. For example, SN2 reactions are vital in drug synthesis and were once used in the production of ibuprofen.

"This is the first paper that answers the question—'What is the dynamic role of the air-water interface in modulating the reaction rate of chemical reactions?" said Vyacheslav Bryantsev, leader of ORNL's Chemical Separations group and co-author of the study, which was published in the Journal of the American Chemical Society. "We confirm in this study that the overall reaction rate at the air-water interface becomes faster compared to the reaction rate in the main environment of water alone."

The team's simulations indicate that chemical reactions involving water and air could be sped up by drawing the interacting molecules out of the water's bulk environment (meaning, deep into the water, away from the interface) and closer to its surface, where air and water interact. This results in a reduction of water's dynamic coupling with those molecules, allowing the chemical reaction to proceed with less interference.

It is expected that water should influence the reaction rate, since it mediates the reaction—however, to what extent and how water controls the reaction were unknown.

"We found that the more the water molecules couple, the more they hinder the reactions. If we can reduce that dynamic coupling, we'll have a faster reaction rate," said Santanu Roy, a scientist in ORNL's Carbon and Composites group and co-author of the study. "Our study suggests that if we can control that coupling by changing the environment at the interface—how water affects the reactions—then we should be able to control the reaction rate."

Using the open-source CP2K code, the ORNL team modeled the reaction trajectories of the molecules on the Summit supercomputer. They then conducted a kinetic analysis of these paths to form an energy profile of the process.

"Our theories would not have been possible to validate or investigate if we didn't have leadership computing power," Roy said. "We needed to run thousands of trajectories—for every point in that energy profile. We had to run a lot of simulations at the electronic level, which takes a lot of

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time, and we had to run all of those in parallel. Without Summit, it's really impossible to do."

Based on previous experimental work that showed that positively charged surfactant molecules will attract negatively charged amino acids, the researchers simulated such a surfactant to draw more amino acids into the interface and confirmed an increased reaction rate of 10% to 15%. The ORNL team's study showed that as a gas reacts with amino acids, it goes through repeated dynamic coupling cycles with the water molecules, slowing down the chemical reaction before finally resolving into a new product.

"The challenge here was to actually understand the role of water and how it controls the reaction rates and their pathways—the mechanism. To do that, we really had to understand the reaction path. This is where Summit came in, and it helped us a lot."

Phys Org, 18 June 2025

https://phys.org

### **Smoking Cessation and Depression Drugs Could Reduce Alcohol Consumption**

#### 2025-06-16

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In addition to lowering alcohol consumption, the combination of the two drugs may also reduce alcohol cravings and decrease the risk of nausea.

Two existing medications—one used for smoking cessation and the other for depression—appear to work effectively together in treating alcohol use disorder. The combination reduces alcohol cravings, lowers consumption, and may decrease the risk of nausea. These findings come from a new study led by the University of Gothenburg, Sweden.

Alcohol use disorder is a serious condition that can shorten the lives of those with severe forms of the disorder by 25 years or more. Yet, existing treatments are effective for only a small subset of patients.

The results are published in The Lancet Regional Health – Europe. The study was carried out in collaboration with researchers from Karolinska Institutet, Lund University, and Linköping University. It introduces a potential new treatment strategy: boosting dopamine levels in the brain.

The researchers based their approach on the hypothesis that a dopamine deficiency drives the craving for alcohol. They aimed to enhance



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dopamine signaling by combining varenicline, which stimulates dopamine release via nicotine receptors, with bupropion, which helps the brain maintain dopamine levels after release.

#### **Reduced consumption in 13-week trial**

A total of 384 individuals with moderate to severe alcohol use disorder took part in the 13-week study. Participants were randomly assigned to one of four groups, receiving either the combination treatment, one of the two drugs alone, or a placebo. Neither the participants nor the researchers knew who received what during the trial.

Results showed the greatest reduction in alcohol consumption among those who received the combination therapy. Varenicline alone also produced a measurable effect. The outcomes were assessed using both blood biomarkers (B-PEth, which indicates whether a person has consumed alcohol regularly over the past few weeks) and self-reporting.

One of the researchers behind the study is Bo Söderpalm, professor of psychiatry at the Sahlgrenska Academy, University of Gothenburg, and senior physician at Sahlgrenska University Hospital.

"We observed approximately twice the effect compared to currently available medications, which is highly promising. However, additional studies are required before the combination treatment can be approved for alcohol use disorder," says Bo Söderpalm.

#### Less nausea improves tolerability

An important secondary finding was that the combination treatment caused less nausea, which is a known side effect of varenicline. Among those who did experience nausea, symptoms lasted for a shorter period of time, similar to what was observed in the placebo group.

Andrea de Bejczy, PhD researcher affiliated with the Sahlgrenska Academy and resident physician at Sahlgrenska University Hospital, played a central role in conducting the study.

"Nausea is a well-known and troublesome side effect of treatment with varenicline. It was surprising but very encouraging to see that nausea decreased when bupropion was added. The fact that the combination

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treatment is more tolerable for patients increases the chances that they will complete the full course of treatment," says Andrea de Bejczy.

Technology Networks, 16 June 2025

https://technologynetworks.com

#### Excessive Oleic Acid, Found in Olive Oil, Drives Fat Cell Growth

#### 2025-06-06

The study found that oleic acid, a monounsaturated fat associated with obesity, causes the body to make more fat cells.

Eating a high-fat diet containing a large amount of oleic acid – a type of fatty acid commonly found in olive oil – could drive obesity more than other types of dietary fats, according to a study published in the journal Cell Reports.

The study found that oleic acid, a monounsaturated fat associated with obesity, causes the body to make more fat cells. By boosting a signaling protein called AKT2 and reducing the activity of a regulating protein called LXR, high levels of oleic acid resulted in faster growth of the precursor cells that form new fat cells.

"We know that the types of fat that people eat have changed during the obesity epidemic. We wanted to know whether simply overeating a diet rich in fat causes obesity, or whether the composition of these fatty acids that make up the oils in the diet is important. Do specific fat molecules trigger responses in the cells?" said Michael Rudolph, PhD, assistant professor of biochemistry and physiology at the University of Oklahoma College of Medicine and member of OU Health Harold Hamm Diabetes Center.

Rudolph and his team, including Matthew Rodeheffer, PhD, of Yale University School of Medicine and other collaborators at Yale and New York University School of Medicine, fed mice a variety of specialized diets enriched in specific individual fatty acids, including those found in coconut oil, peanut oil, milk, lard and soybean oil. Oleic acid was the only one that caused the precursor cells that give rise to fat cells to proliferate more than other fatty acids.

"You can think of the fat cells as an army," Rudolph said. "When you give oleic acid, it initially increases the number of 'fat cell soldiers' in the army, which creates a larger capacity to store excess dietary nutrients. Over



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# **Curiosities**

time, if the excess nutrients overtake the number of fat cells, obesity can occur, which can then lead to cardiovascular disease or diabetes if not controlled."

Unfortunately, it's not guite so easy to isolate different fatty acids in a human diet. People generally consume a complex mixture if they have cream in their coffee, a salad for lunch and meat and pasta for dinner. However, Rudolph said, there are increasing levels of oleic acid in the food supply, particularly when access to food variety is limited and fast food is an affordable option.

"I think the take-home message is moderation and to consume fats from a variety of different sources," he said. "Relatively balanced levels of oleic acid seem to be beneficial, but higher and prolonged levels may be detrimental. If someone is at risk for heart disease, high levels of oleic acid may not be a good idea."

Technology Networks, 6 June 2025

https://technologynetworks.com

### JUN. 20, 2025

# **Technical Notes**

#### **(NOTE: OPEN YOUR WEB BROWSER AND CLICK ON HEADING TO LINK TO SECTION**)

#### **CHEMICAL EFFECTS**

CHEMWATCH

Assessing the phytotoxicity of emerging pollutants on vegetable crops grown with sewage effluent

Effects of global treaties on commercial chemicals widely used as additives: a meta-analysis of historical measurements of polybrominated diphenyl ethers

Approaches to managing ototoxicity in the workplace

#### ENVIRONMENTAL RESEARCH

Environmental and occupational exposure to erionite and related health risks: progress and prospects

Maternal exposures to ambient carbon particulate pollution and the risk of gestational hypertension or pre-eclampsia: a retrospective cohort study in Beijing, China, 2014-2018

#### PHARMACEUTICAL/TOXICOLOGY

Buccal micronucleus cytome assay to evaluate cyto-genotoxic effects of occupational exposure to antineoplastic drugs: application on a large sample size of workers furnished by an Italian network of oncological hospitals

A case-control study of early-life residential exposure to tetrachloroethylene and risks of childhood cancer and birth defects

Silver Nanoparticles (AgNPs) as a Double-Edged Sword: Synthesis, Factors Affecating, Mechanisms of Toxicity and Anticancer Potentials-An Updated Review till March 2025

#### **OCCUPATIONAL**

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Oxidative damage, genetic and epigenetic alterations in hexavalent chromium exposed workers - A cross-sectional study within the SafeChrom project

Inhalational exposures associated with risk of interstitial lung disease: a systematic review and meta-analysis



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