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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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ASIA PACIFIC

Tailored guidance pathways complete

2020-10-15

We've published our final tailored guidance pathway, to assist with applications to vary the dose, frequency or route of administration for a veterinary medicine product.

Designed to provide industry with current and clear guidance for the most common application types, the release of the final pathway marks the end of our 'Top 20' project to develop and improve guidance material for stakeholders.

Australian Pesticides and Veterinary Medicines Authority (APVMA) Chief Executive Officer, Ms Lisa Croft, said the completion of the Top 20 project demonstrates the APVMA's commitment to supporting growth in Australia's agricultural and veterinary (agvet) chemical sector.

"We engaged with industry to identify the top 20 application types for which they required improved guidance, and held a series of workshops to ensure areas for improvement and industry priorities were understood and captured," said Ms Croft.

"Our suite of tailored guidance pathways has been designed to make the registration process easier and more efficient for industry applicants, to support timely access to safe and effective agvet chemical products for the Australian community."

The full list of tailored guidance pathways is available on the APVMA website.

APVMA, 15 October 2020

<https://apvma.gov.au/>

Regulation to play a key role in India's gas ambitions

2020-10-15

The US experience suggests building pipelines is not enough. An effective regulatory regime is also required

India's government has in recent months reaffirmed its commitment to the development of an expanded domestic gas grid and cross-border interconnections such as the long-mooted Turkmenistan-Afghanistan-Pakistan-India pipeline. But the experience of the US gas market suggests

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that smart and considered government gas transport regulation could play as crucial a role in boosting Indian gas demand as simply increasing pipeline capacity.

To curb its greenhouse gas emissions and reduce air pollution, India plans to increase the proportion of gas in its energy mix from 6.2pc in 2018 to 15pc by 2030. To achieve its target, India has committed to invest \$60bn to expand its gas grid and LNG import terminals by 2024, when prime minister Narendra Modi's current term ends.

Insufficient connections have led to low utilisation of gas in India's towns and industry. But current pipeline investments aim to build infrastructure connecting all of India's 28 states.

Full Article

Petroleum Economist, 15 October 2020

<https://www.petroleum-economist.com/articles/midstream-downstream/pipelines/2020/regulation-to-play-a-key-role-in-india-s-gas-ambitions>

NSW silicosis laws need reform, MP says, as stonemason calls for change

2020-10-16

New laws designed to prevent the lung disease silicosis will come too late for former stonemason Kyle Goodwin, but he hopes future generations of construction workers and miners will be protected.

The Tenterfield, New South Wales resident, who worked the engineered stone commonly used in modern kitchen benchtops, was diagnosed with advanced silicosis two years ago.

The disease is caused by exposure to silica, which is released as dust particles when engineered stone is cut, drilled and polished.

Doctors have given the 35-year-old between five and 10 years to live.

"I'm trying to keep it out of my mind — if you live thinking you only have five years left, you're not going to have much of a life," Mr Goodwin said.

"I couldn't even count how many people I know who have been diagnosed, and they're young guys with young families who may not live to see their children grow up.

Doctors have given the 35-year-old between five and 10 years to live.

We've published our final tailored guidance pathway, to assist with applications to vary the dose, frequency or route of administration for a veterinary medicine product.

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“For those of us who are already diagnosed, given there’s no cure, there’s no real hope.

Stricter measures proposed

A proposed amendment to the Work Health and Safety Act is before NSW Parliament, calling for the establishment of a dust diseases register like that in Queensland.

Labor’s Daniel Mookhey introduced the amendment, which he said took a tougher approach than reforms introduced by the Government in July that made silicosis a notifiable disease in NSW.

“Under the NSW Government’s proposal, all that happens is that NSW Health can, if they choose, exchange information with the regulator, and they can withhold that information from the regulator and they can withhold it in secret,” he said.

“Under the proposal we’re pushing, NSW Health must inform the regulator every time a person is occupationally exposed to silica dust and diagnosed with silicosis, and the regulator has to investigate that notification.

“Equally, the number of notifications would be public ... when it comes to something as deadly as silicosis, the imperative is to give the public more information, not less.”

[Full Article](#)

ABC News, 16 October 2020

<https://www.abc.net.au/news/2020-10-16/silicosis-push-to-protect-workers-from-deadly-lung-disease/12748468>

AMERICA

EPA seeks to speed up long-lasting Coronavirus disinfectants

2020-10-15

The EPA announced on Wednesday a faster process for approving new products that can keep surfaces clean of the coronavirus for several days and could result in chemical companies getting products onto the market faster.

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Products that make claims of long-term effectiveness will move “to the front of the line” for agency review under the draft guidance, Alexandra Dunn, the the Environmental Protection Agency’s assistant administrator for chemical safety and pollution prevention, said during a press call.

The announcement comes as the Trump administration is racing to push ahead new treatments and protections against the virus.

Manufacturers have been coming forward with many types of disinfectants that don’t require constant wiping, Dunn said. The EPA’s new roadmap gives companies guidance on the kinds of scientific data the agency needs so it can process its reviews and possible approvals faster, she said.

The guidance is aimed at two categories of products: supplemental residual antimicrobial products that don’t replace regular cleaning but can nevertheless offer protection for weeks or even years, and residual disinfectants, which take effect within 10 minutes of a virus contacting a surface and remain effective for up to 24 hours.

“As we continue to re-open our schools, workplaces, and other public spaces, it is important Americans have as many tools as possible to slow the spread of Covid-19,” EPA chief Andrew Wheeler said in a statement.

[Full Article](#)

Bloomberg Law, 15 October 2020

<https://news.bloomberglaw.com/environment-and-energy/epa-seeks-to-speed-up-long-lasting-coronavirus-disinfectants>

New York says goodbye to 6 dirty power plants and hello to working with communities

2020-10-15

New York’s latest move toward its aggressive decarbonization goals makes good on the promise of a more equitable transition. On Tuesday, the New York Power Authority (NYPA), a publicly owned power utility, announced an agreement to work with environmental justice groups on a plan to transition six natural gas-fired power plants in New York City to cleaner technologies.

These are not just any power plants. The six facilities in question are “peaker plants,” designed to fire up only during times of peak demand,

These are not just any power plants.

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like hot summer days when New Yorkers are cranking up their air conditioners — and air quality is already compromised.

Peaker plants typically operate less than 10 percent of the time, but they have an outsized effect on communities and the environment. Of the city's 16 peaker plants, most of them are at least 50 years old, and some run on especially dirty fuels like oil or kerosene. These old plants are disproportionately located in communities of color in the Bronx, Brooklyn, and Queens that are simultaneously burdened with other health risks like [heat vulnerability](#). In addition to emitting carbon dioxide that is heating up the planet, they release harmful pollutants like nitrogen oxides, sulfur oxides, and tiny, easily inhalable particles that contribute to respiratory issues.

[Full Article](#)

Grist, 15 October 2020

<https://grist.org/justice/new-york-says-goodbye-to-6-dirty-power-plants-and-hello-to-working-with-communities/>

The U.S. still uses many pesticides banned in other countries

2020-10-14

A total of about 400 different agricultural pesticides were used in the United States in 2017, the latest year data is available. More and more pesticides have been used because they “contribute to higher yields and improved product quality by controlling weeds, insects, nematodes, and plant pathogens,” according to the U.S. Department of Agriculture.

However, the USDA noted, pesticides pose consequences for people's health and the environment.

[Full Article](#)

Midwest Center for Investigative Reporting, 14 October 2020

<https://investigatmidwest.org/2020/10/14/graphic-the-u-s-still-uses-many-pesticides-banned-in-other-countries/>

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OCT. 23, 2020

EPA announces expedited pathway for companies to claim “long-lasting” efficacy for antiviral products

2020-10-14

On October 14, 2020, the U.S. Environmental Protection Agency (EPA) released much-anticipated **draft guidance** that will allow companies to demonstrate that their products have “long-lasting” or “residual” effectiveness on surfaces against viruses like SARS-CoV-2, the coronavirus that causes COVID-19. As most know, EPA has not before now provided guidance on how stakeholders can demonstrate to EPA's satisfaction that their product remains efficacious for periods of time, given the broad diversity of contact opportunities and scenarios. Importantly, EPA states that pursuant to Title VII of the Coronavirus Aid, Relief, and Economic Security (CARES) Act, it is providing notice of its intention to expedite reviews for addition of residual (i.e., extended or long-lasting) efficacy claims for currently registered or new product registrations that are on EPA's Disinfectant List N, that would qualify for List N, or products that can be used as a residual supplement to disinfectants on List N. The guidance specifies scientific testing requirements for two different types of products, supplemental residual antimicrobial products and residual disinfectants. According to EPA, supplemental residual antimicrobial products work within two hours of a virus or bacteria coming into contact with a surface and can remain effective for weeks to years. EPA notes that these products can supplement, but do not replace, routine cleaning and disinfection using products from **EPA's List N: Disinfectants for Use Against SARS-CoV-2 (COVID-19)**. Approved supplemental residual antimicrobial products are not eligible for inclusion on List N, but EPA will add them to a separate **List N appendix**.

[Full Article](#)

Pesticide Law and Policy Blog, 14 October 2020

<http://pesticideblog.lawbc.com/entry/epa-announces-expedited-pathway-for-companies-to-claim-long-lasting-fficac>

On October 14, 2020, the U.S.

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EUROPE

Finland aims to reach carbon neutrality in 2035, go carbon negative soon after

2020-10-15

Finland has communicated its long-term low greenhouse gas (GHG) emission development strategy (LEDS) to the UNFCCC. Finland's LEDS charts scenarios and impact assessments to achieve its 2035 carbon neutrality target, and reviews longer-term emissions reduction and removal opportunities by 2050.

The LEDS assesses Finland's emissions reduction potential and needs by sector in three scenarios concerning the country's 2035 carbon neutrality target. The reference scenario reviews development that would be achievable with current policy measures in place. It determines that carbon neutrality would not be possible until 2050, and even then only by leveraging 30 MtCO₂eq of land use net sinks.

The 'Continuous Growth' scenario achieves an 87.5% reduction in GHG emissions by 2050 compared to 1990 levels. The corresponding target under the 'Savings' scenario achieves 90% GHG emission reductions. Both achieve carbon neutrality in 2035, and exclude the land-use sector from calculations. Neither scenario sets carbon-negative targets beyond 2035, rather they allow this level "to be determined by the size of the net carbon sink of the land use sector." The Continuous Growth and Savings scenarios differ in their underlying technology assumptions, most significantly the viability of carbon capture and storage (CCS), as well as increases in energy efficiency and sustainable biorefinery production. The difference in the scenarios is also accounted for by differing assumptions on the structures of industry, society, and the economy as a whole.

The LEDS analyzes the emissions reduction potential and needs of the energy, industry, transport, waste, and land use sectors. The Strategy does not specifically identify the sectors to which emission reductions should be allocated, nor does it include quantitative analysis of specific policies needed to achieve the 2035 and 2050 targets. These, it states, will be decided in 2020-2021 as part of the country's process of drafting the Climate and Energy Strategy, the Medium-term Climate Change Policy Plan, the roadmap for fossil-free transport, and the climate programme for the land use sector. Rather than consider emissions reductions from a regional or social justice perspective, Finland's LEDS bases its calculations

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on the premise that emission reduction costs should be minimized across the country.

Full Article

SDG Knowledge Hub, 15 October 2020

<http://sdg.iisd.org/news/finland-aims-to-reach-carbon-neutrality-in-2035-go-carbon-negative-soon-after>

Reducing greenhouse gas emissions: Commission adopts EU Methane strategy as part of European Green Deal

2020-10-14

The European Commission presented today an EU strategy to reduce methane emissions. Methane is the second biggest contributor to climate change, after carbon dioxide. It is also a potent local air pollutant causing serious health problems. Tackling methane emissions is therefore essential to reaching our 2030 climate targets and the 2050 climate neutrality goal, as well as contributing to the Commission's zero-pollution ambition.

This strategy sets out measures to cut methane emissions in Europe and internationally. It presents legislative and non-legislative actions in the energy, agriculture and waste sectors, which account for around 95% of methane emissions associated with human activity worldwide. The Commission will work with the EU's international partners and with industry to achieve emission reductions along the supply chain.

Frans Timmermans, Executive Vice-President for the Green Deal, said, "To become the first climate-neutral continent, the European Union will have to cut all greenhouse gases. Methane is the second most powerful greenhouse gas and an important cause of air pollution. Our methane strategy ensures emissions cuts in all sectors, especially agriculture, energy, and waste. It also creates opportunities for rural areas to produce biogas from waste. The European Union's satellite technology will enable us to closely monitor emissions and help raise international standards."

Full Article

European Commission, 14 October 2020

https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1833

Methane is the second biggest contributor to climate change, after carbon dioxide.

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INTERNATIONAL

PFAS in food limit set by Europe—will the U.S. follow?

2020-10-14

On September 17, 2020, the European Food Safety Authority (EFSA) announced the publication of the final version of its latest scientific opinion on the risk to human health from the presence of PFAS in food. The EFSA determined that a tolerable weekly intake (TWI) level of 4.4 nanograms per kilogram of body weight from food was appropriate. The TWI level applies to four PFAS – PFOA, PFOS, PFHxS, and PFNA. The EFSA issued its revised TWI after a two month comment period and several months spent considering the comments.

Previously, in 2018, the EFSA established food intake levels for two PFAS – PFOS and PFOA; however, the limit set at the time was 13 nanograms per kilogram of body weight for PFOS and 6 nanograms per kilogram of body weight for PFOA. The agency indicated that it re-evaluated these levels and included two additional types of PFAS due to the growing body of scientific literature related to PFAS in food.

The EFSA is the agency of the European Union (EU) that provides scientific advice and recommendations on existing and potential risks associated with the food chain. Established in 2002, the EFSA has wide latitude in recommending to the EU regulations that impact food supply chains, including food for both human and animal consumption, animal health and welfare, plant protection and overall plant health.

The EFSA's publication with respect to PFAS in food is significant for two reasons. First, it is the latest PFAS regulation out of the EU in 2020, which has already seen much action on the regulatory front for PFAS. Significantly, the EU is expected to announce its decision in the fall of 2020 as to whether it will issue "action steps" for PFAS, which may include a ban on all types of PFAS for some applications. This would be a significant regulation, as it would be one of the first to regulate the thousands of PFAS chemicals in one sweeping regulations.

Second, while the EU is generally seen as ahead of the United States regulatory agencies in many areas, including PFAS, the EFSA's determination may place increasing pressure on other global regulatory bodies, including the World Health Organization, to make similar findings or at least lend support to the regulations. This, in turn, will place pressure on agencies in the United States (primarily, the FDA, which regulates

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food safety in the United States) to set limits for PFAS in food. Thus far, the biggest pressure point for PFAS regulation in the United States has been with respect to drinking water, which is seen as the most prevalent form of PFAS consumption by citizens. However, food may find itself not far behind in the public outcry realm, as it is only natural that food and water consumption, as the most direct sources of PFAS ingestion, will be tackled first by agencies looking to respond to ever-increasing public pressure.

Full Article

The National Law Review, 14 October 2020

<https://www.natlawreview.com/article/pfas-food-limit-set-europe-will-us-follow>

The TWI level applies to four PFAS – PFOA, PFOS, PFHxS, and PFNA.

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REACH Update

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EU plans big change in regulation of chemicals

2020-10-14

Strategy calls for bans on groups of substances based on health effects

The European Union is considering a sweeping new approach that would shift from assessing commercial chemicals and their uses one by one to regulating groups of substances that can cause similar toxic effects.

Unveiled Oct. 14 by the European Commission, the EU's main policymaking organ, the strategy would also promote the development and use of chemicals that are designed to be safe and sustainable. This effort would involve some public funding to companies to support innovation.

The Commission's plan is designed to help implement the European Green Deal, the EU's growth strategy to become a sustainable, climate-neutral, and circular economy, in which waste becomes raw materials, by 2050.

The strategy calls for a major policy change from the EU's current procedure, which involves evaluating individual chemicals and each of their uses before deciding which to regulate and how stringently. The US evaluates chemicals similarly.

The Commission instead proposes following a path set out by the EU's current approach to carcinogens: generally ban from consumer products groups of substances that pose similar harmful effects while allowing limited exemptions under specified conditions. The strategy would first expand from carcinogens to ban, in consumer products, chemicals that affect the endocrine system or reproduction or that are persistent and bioaccumulative. Next in line for this approach would be substances that adversely affect the immune, nervous, or respiratory systems and compounds that are toxic to a specific organ.

Cefic, the European chemical trade association, gives the strategy mixed reviews. The group endorses the concept of chemicals that are sustainable by design and the plan's suggestions that the EU will more strongly enforce its chemical regulations for imports, Cefic Director General Marco Mensink says in a statement. However, he says, the strategy "should strike a better balance between simply banning chemicals based on their hazardous properties and enabling the technology solutions that will make the Green Deal reality."

The US evaluates chemicals similarly.

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The plan now goes to European Parliament and the European Council, which serves as a branch of the legislature, for consideration

Chemical & Engineering News, 14 October 2020

<https://cen.acs.org/policy/chemical-regulation/EU-plans-big-change-regulation/98/i40>

ECHA ready to help the EU achieve its ambitions for safe and sustainable chemicals

2020-10-14

The European Commission has published its Chemicals Strategy for Sustainability as part of the European Green Deal. ECHA welcomes the strategy and looks forward to supporting its implementation.

Helsinki, 14 October 2020 – The chemicals strategy highlights that chemicals are fundamental for society and that a robust framework is needed to make the legislation stronger and more coherent.

It presents several actions for a toxic-free environment to protect people and the environment from hazardous chemicals. ECHA can play a key role in many of these areas with its scientific and technical competences.

Bjorn Hansen, ECHA's Executive Director says: "European citizens are concerned about chemicals, and we need to make sure these concerns are addressed. At ECHA, we can play our part in making this strategy a success by supporting the Commission and EU Member States together with our stakeholders. We can particularly contribute in three areas: collecting, publishing and evaluating data on chemicals to stimulate innovation towards safer alternatives; ensuring that laws are implemented more efficiently and consistently; and speeding up chemicals risk management in the EU."

ECHA's vision is to be the centre of knowledge on the sustainable management of chemicals, serving a wide range of EU policies and global initiatives, for the benefit of citizens and the environment.

Full Article

ECHA, 14 October 2020

<https://echa.europa.eu/-/echa-ready-to-help-the-eu-achieve-its-ambitions-for-safe-and-sustainable-chemicals>

It presents several actions for a toxic-free environment to protect people and the environment from hazardous chemicals

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REACH Update

OCT. 23, 2020

Consultations start on authorisation substitution plans

2020-10-13

The substitution plans of four applications for authorisation to use a substance of very high concern will open for consultation on 21 October 2020. ECHA's Committee for Socio-economic Analysis (SEAC) will evaluate the plans and the information received during the consultation to provide scientific underpinning for the European Commission to decide whether or not to grant the authorisations.

Helsinki, 13 October 2020 – The substitution plans of 12 applications need to be evaluated by SEAC following a specific request from the Commission to these applicants. The Commission's request is a result of a 2019 General Court judgment, which changed the interpretation concerning the suitability of alternatives. Applicants are required to prepare substitution plans and include them in their applications if suitable alternatives are available for their uses *in general* – although these alternatives might not be technically or economically feasible for the applicant.

The plans of four applications have now been sent to ECHA. These concern the use of hexavalent chromium in surface treatments and the curing agent MOCA. The 4-week consultation will take place from 21 October to 18 November 2020. The plans are already published on ECHA's website.

The substitution plans of the remaining eight applications are expected to arrive by early December and they will be opened for consultation by mid-December. These plans are for uses of the plasticiser DEHP, hexavalent chromium in surface treatments and sodium dichromate in wool dyeing.

SEAC will evaluate the credibility and completeness of the plans from a scientific viewpoint. It has started working on the first batch of substitution plans and is expected to finalise the assessment by June 2021. The evaluation of the second batch is expected to be completed by September 2021.

The substitution plans will be sent to the Commission, together with SEAC's evaluation, as an addendum to the original opinions. The Commission will then decide whether to grant or refuse the authorisation.

The plans of four applications have now been sent to ECHA.

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Full Article

ECHA, 13 October 2020

<https://echa.europa.eu/-/consultations-start-on-authorisation-substitution-plans>

Biocides committee backs approval of two active substances used in disinfectants

2020-10-13

ECHA's Biocidal Products Committee (BPC) also supports a Union-wide authorisation for an insecticide containing clothianidin and pyriproxyfen.

Helsinki, 13 October 2020 – The BPC backs the approval of the following active substance product-type combinations:

- ADBAC/BKC and DDAC for use in animal hygiene products such as disinfectants and oral or corporal hygiene products (product-type 3) and in products used to disinfect e.g. equipment, containers and surfaces needed in the production, transport, storage or consumption of food or feed for people and animals (product-type 4).

The application for Union authorisation concerns a biocidal product with the following insecticides:

- clothianidin and pyriproxyfen for use in pest control against insects, arachnids and other arthropods (product-type 18).

In addition, the BPC discussed and agreed on the revised working procedures for active substance approvals and Union authorisation. The revised procedures will be published later on the committee's web page.

The European Commission together with EU Member States will take the final decision on the approval of the active substances and on the Union authorisation of biocidal products.

Full Article

ECHA, 13 October 2020

<https://echa.europa.eu/-/biocides-committee-backs-approval-of-two-active-substances-used-in-disinfectants>

ECHA's Biocidal Products Committee (BPC) also supports a Union-wide authorisation for an insecticide containing clothianidin and pyriproxyfen.

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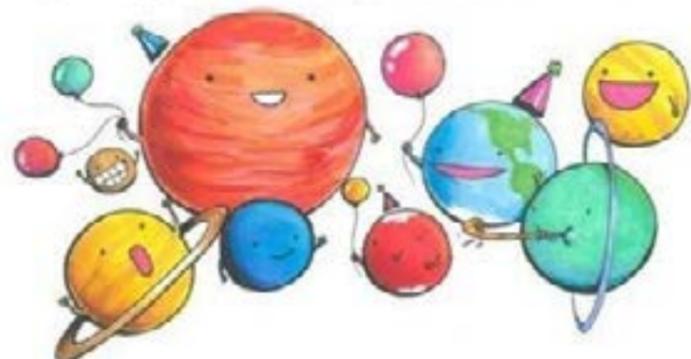
Janet's Corner

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A space party

2020-10-23

HOW DO YOU ORGANIZE
A SPACE PARTY?



YOU PLANET.

<https://cheezburger.com/2424325/nerd-out-23-mostly-painful-science-puns>

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Hazard Alert

OCT. 23, 2020

Acetic Acid

2020-10-23

Acetic acid, aka ethanoic acid and E260, is the second simplest carboxylic acid. When it is pure acetic acid, it is called glacial acetic acid. Its formula is CH_3COOH , and it has a distinctive pungent smell and taste. It is a clear, colourless liquid. [1,2,3,4,5]

USES [4,5]

Acetic acid is the main ingredient in vinegar; the condiment contains between 3-9% acetic acid. The acid is also used as a food additive (aka E260), for flavour and as an acidity regulator. It is used to make polyvinyl and cellulose acetate. Large quantities of the acid are used to make ink for dyes, pharmaceuticals, photographic chemicals, rubber and plastics. It is also used in some household cleaning products.

ROUTES OF EXPOSURE [6]

- Routes of exposure include inhalation and skin/eye contact.

HEALTH EFFECTS

Acetic acid poisoning affects a range of systems, including the integumentary and respiratory systems.

Acute Effects [7]

Severity of symptoms depend on the level and type of exposure.

Inhalation of the acid may result in irritation of the respiratory tract, resulting in coughing, mucous membrane damage and choking. It could also cause dizziness, headaches, weakness, nausea and pulmonary oedema. It may cause transient loss of voice. Ingestion of the acid may result in burns on the mucous membranes of the throat, mouth and oesophagus. It may also cause nausea, vomiting, diarrhoea, shock (including clammy skin and shallow breathing), convulsions or a coma. Skin and eye contact could result in pain and burns, which may heal at a slow pace. Direct eye contact with the acid may result in lachrymation, burns and photophobia. Severe burns could result in permanent damage, but milder burns tend to heal quickly.

Acetic acid, aka ethanoic acid and E260, is the second simplest carboxylic acid.

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Chronic Effects [7]

Chronic exposure to acetic acid is toxic to multiple body systems. Long term exposure to the acid can result in erosion of the teeth, ulcerative changes in the mouth, bronchial irritation (including a cough and frequent bouts of bronchial pneumonia), and gastrointestinal disturbances. Chronic exposure to the acid can also result in systemic breathing problems, blackening of the skin and teeth, nausea, vomiting, diarrhoea, and chronic respiratory inflammation.

~h1Safety

First Aid Measures [7]

- Ingestion: DO NOT induce vomiting. Move patient into recovery position. If the person is conscious (and not showing any signs of drowsiness), then you can give them water to rinse their mouth. Contact a medical professional immediately.
- Skin contact: Remove all contaminated clothing, footwear and accessories. Do not re-wear clothing until it has been thoroughly decontaminated. Immediately rinse affected areas with plenty of soap and water. Contact a doctor immediately.
- Eye contact: Flush eyes (including under the eyelids), with fresh running water for at least 15 minutes. Removal of contact lenses should only be done by skilled personnel. Contact a medical professional immediately.
- Inhalation: If the person inhales fumes, combustion products or aerosols, remove them from the contaminated site. Prostheses, such as false teeth, should be removed prior to first aid procedures, as they may block airways. Perform CPR if you are qualified and if the patient is unconscious and not breathing. Use a one-way valve and mask if possible. Immediately contact a medical professional.
- General: Never administer anything by mouth to an unconscious, exposed person.

Exposure Controls/Personal Protection [7]

- Engineering controls: Emergency eyewash fountains and quick-drench areas should be accessible in the immediate area of the potential exposure. Ensure there is adequate ventilation.
- Personal protection: Safety glasses with side shields or chemical goggles, protective and dustproof clothing, gloves (do not wear polyethylene gloves; wear elbow length PVC gloves), a P.V.C apron and

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Hazard Alert

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an appropriate mask or dusk respirator. Do not wear contact lenses as they could absorb chemicals in the air. Wear impervious shoes. Other protection could overalls. For specifications regarding other PPE, follow the guidelines set in your jurisdiction.

REGULATION [6]

United States:

The National Institute for Occupational Safety and Health (NIOSH) has set a Time Weighted Average (TWA) concentration limit for acetic acid of 10ppm.

Australia [7]

Australia Exposure Standards have set a TWA for acetic acid of 10ppm.

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Farmers are facing a phosphorus crisis. The solution starts with soil

2020-10-14

ON AN OVERCAST day, Roger Sylvester-Bradley walks along a hawthorn hedge, collecting a thick rind of mud on his leather boots, before stepping into a gently sloping field of barley.

He stoops to pluck an ankle-high seedling from the ground and examines its healthy mop of fine white roots. Turning them in his hands, he says, “when you see a plant that’s deficient in phosphorus, it doesn’t look like this.”

That’s something of a surprise to Sylvester-Bradley, a crop scientist at [ADAS](#), an agricultural consulting company in Cambridge, England. Phosphorus occurs naturally in soil and is a critical nutrient for plant growth. For centuries, farmers have added extra to their fields to boost harvests, but Sylvester-Bradley and his colleagues are studying ways to produce food using less of it.

The reasons are twofold: First, phosphorus runoff from farms contributes to widespread water pollution. Second, we don’t have phosphorus to waste.

Nearly all of the phosphorus that farmers use today—and that we consume in the food we eat—is mined from a few sources of phosphate rock, mainly in the United States, China, and Morocco. By some estimates, those could run out in as little as 50 to 100 years. Geologists know of other deposits, but they are harder to access and contain less phosphorus. Thus, the price will likely rise, making it harder for growers to afford fertilizer and for people to afford food.

Here and at other experimental sites in England, Sylvester-Bradley and his colleagues have taken a first commonsense step toward addressing the problem: They stopped adding phosphorus fertilizer to half the barley field to see how the plants would fare. Eight years later, they have only just started to observe the first effects on crop size and yield. The plants have survived on the excess nutrients in the soil—so-called legacy phosphorus—which some say represents a key piece of the phosphorus puzzle.

Researchers have calculated that, in countries like the United Kingdom and the United States, there is already billions of dollars’ worth of fertilizer

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in the ground that could help offset demand for mined phosphorus. Using it up would also curb phosphorus runoff.

To Paul Withers, a soil scientist at Lancaster University and one of Sylvester-Bradley’s collaborators, tapping into legacy phosphorus is a no-brainer and continuing with the status quo is a recipe for both ecological and humanitarian disaster. “We can’t have agriculture polluting the environment and using resources the way we are,” Withers says. “It’s just going to cause a meltdown in the end.”

A devious nutrient

Phosphorus is a non-negotiable requirement for life. It’s the backbone of DNA and the P in ATP—the molecule that carries energy around cells. Plants need phosphorus to grow, which is why farmers have been feeding it to their crops for millennia.

At first, and without understanding the chemistry, people used manure and human waste as fertilizer. Then in the 1800s farmers recognized that phosphorus-rich bones and rocks worked too.

In 1842 an Oxford University dropout named John Bennet Lawes patented a process for treating these new mineral forms of phosphorus with acid, making the nutrient more accessible to plants, and soon began selling the world’s first human-made fertilizer.

Lawes plowed his considerable profits back into research at his family’s country estate, which later became the Rothamsted Research center. And there, scientists discovered that phosphorus was a somewhat devious nutrient.

The fertilizer Lawes manufactured contained a soluble, inorganic form of phosphorus that plants can readily use. But as soon as the phosphorus hit the soil, a large fraction of it reacted with soil minerals, forming compounds that crops can’t access. Some also got locked away in equally unavailable organic forms.

From those observations, scientists concluded that farmers shouldn’t scrimp on phosphorus. They should heap it on, especially as they raced to feed the world’s growing populations during the 20th century.

In fact, it was once Withers’ job to spread the word. As a government farm advisor in the 1980s, he drove a red Volvo station wagon around the winding roads of rural England telling farmers to make sure their crops got plenty of key nutrients.

Second, we don’t have phosphorus to waste.

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This method, which Withers calls “insurance-based farming,” still prevails in many parts of the world. In Europe, farmers apply roughly 4 kilograms of phosphorus for each kilogram that we consume in food. For U.S. diets, that ratio is about 9 to 1, and in China, it may be as high as 13 to 1. (There are crucial exceptions in places where farmers have never had adequate access to phosphorus fertilizer, like many parts of Africa and South America.)

Phosphorus is lost at many stages of food production and processing. But these inefficiencies pose a problem as looming changes in phosphorus availability and price threaten to destabilize the world’s food system, Withers says. “We’ve sort of gone over the top and we’ve come back to vulnerability.”

To make matters worse, some unused fertilizer builds up in the soil, which causes environmental problems long after it’s applied, says Helen Jarvie, a hydrochemist at the Centre for Ecology and Hydrology in Wallingford, U.K. Her research shows that it slowly leaks into the environment for decades, confounding well-intentioned efforts by landowners to reduce nutrient pollution.

Even small amounts of phosphorus runoff from farms and sewage are enough to fuel algal blooms that fill waterways with festering green scum. Sometimes, like in Lake Erie, they produce toxins that can foul drinking water and use up dissolved oxygen, killing fish and other aquatic life.

According to one study, phosphorus pollution affects nearly 40 percent of Earth’s land areas. And the damage adds up. By one estimate, the impacts of excess phosphorus and nitrogen—another key nutrient—on water quality and ecosystems cost \$2.2 billion per year in the U.S. alone.

A slam dunk for plants?

If legacy phosphorus is an environmental liability, it is also a tremendous opportunity, according to Withers and other scientists. He and his colleagues calculated in a 2015 study that fields in the United Kingdom contain more than \$10 billion worth of phosphorus, enough to meet the country’s fertilizer demand for up to 54 years.

Many other nations possess similar reserves. A 2012 analysis found that global soils contain enough legacy phosphorus to cut the projected demand for new fertilizer in half by 2050.

“The plants can use our mistakes from the past,” says Sheida Sattari, lead author of the study.

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By the numbers, legacy phosphorus looks like a slam dunk. But can plants actually live on it? Studies suggest that, in places with long histories of phosphorus overuse, like the U.K., crops can thrive for 10 years or more on the stores built up in the ground. The most extreme example comes from Saskatchewan, where researchers haven’t added phosphorus to plots of wheat since 1995. Twenty-five years later they still haven’t seen problems.

Conventional measures of soil chemistry suggest they should apply more fertilizer, says Barbara Cade-Menun, who oversees the experiments at the Swift Current Research and Development Center in Canada. “But our yields aren’t changing.”

Scientists think that as plants use up the readily available phosphorus in the fields, soil minerals and organic matter release more of the nutrient. Cade-Menun doesn’t yet know whether changes in soil chemistry, soil microbes, or plants themselves can explain what’s happening in her plots. Regardless, the results suggest that those inaccessible forms of phosphorus that the Rothamsted researchers fretted about aren’t quite as off-limits as scientists once thought.

And that means just cutting back on fertilizer could go a long way to meeting phosphorus demand and reducing runoff without jeopardizing harvests.

Smarter crops

At some point, however, soil phosphorus drops low enough that crops become stressed. That’s partly because some of it really is out of reach for plants, but also because many modern crops cannot get ahold of what is there.

The scarcity of phosphorus in nature forced wild plants to develop strategies for securing an adequate supply. Many evolved extensive root systems that search out phosphorus. Some can also excrete chemicals to liberate the nutrient from the soil.

But most commercial crops don’t have those abilities. Scientists cultivated them in well-fertilized soils that didn’t require plants to spend energy deploying such tools. And, in a world of plentiful resources, breeders didn’t select for varieties with strong phosphorus-harvesting traits. The result, says Phil Haygarth, a soil scientist at Lancaster University, is “a load of fast-growing, dumb plants” that struggle to extract phosphorus from the soil.

Researchers now want to create smarter crops. In 2012, scientists identified a gene in an ancient variety of Japanese rice that enhanced

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the plant's ability to find phosphorus by growing fine roots. Researchers then bred the trait into modern rice plants, and in 2019 farmers in Madagascar—which has naturally nutrient-poor soils—started testing some of the most promising varieties.

Sigrid Heuer, a researcher at Rothamsted who helped with the rice study, is searching for a similar gene in wheat as part of the [International Wheat Yield Partnership](#). Other scientists are developing crop varieties that don't need as much phosphorus in the first place.

Besides breeding, no-till farming could help by preventing soil compaction and encouraging good root development to help plants access more legacy phosphorus. Adding symbiotic fungi that spread through the soil may extend a plant's underground reach, and growing crops alongside legumes and other plants that secrete phosphorus-releasing compounds can free up more of the nutrient.

Withers and Sylvester-Bradley have been running down the phosphorus levels in their test fields for the exact purpose of exploring these kinds of approaches.

The researchers had to abandon the barley field in Cambridge because of changes in farm ownership. But at the remaining sites, phosphorus levels have finally dipped low enough for them to start conducting experiments on how to help plants access as much legacy phosphorus as possible. The first will compare the performance of existing commercial wheat varieties.

The researchers had to wait longer than expected—nearly a decade—for phosphorus levels to drop back to natural levels. But that fact alone should reassure growers that they can safely cut back on the nutrient, Sylvester-Bradley says.

"The take-home for farmers, as far as I'm concerned, is they can relax."

[nationalgeographic.com](#), 14 October 2020

<https://www.nationalgeographic.com>

A newly discovered protein repairs DNA

2020-10-14

Researchers from the University of Seville, in collaboration with colleagues from the Universities of Murcia and Marburg (Germany) have identified a new protein that makes it possible to repair DNA. The protein in question,

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called cryptochrome, has evolved to acquire this and other functions within the cell.

Ultraviolet radiation can damage the DNA, leading to mutations that disrupt cell function and can allow cancer cells to grow out of control. Our cells have DNA repair systems to defend themselves against this sort of damage. One of these systems is based on a protein, photolyase, which uses [blue light](#) to repair DNA damage before it leads to mutations.

Over the course of evolution, the genes for photolyase duplicated and became specialized, creating new proteins, cryptochromes, which have honed their ability to perceive blue light and now perform other functions in cells. For example, cryptochromes use blue light as a signal to regulate [plant growth](#) and the rhythm that controls daily activity (the circadian rhythm) in fungi and animals.

The authors of this study discovered that in the fungus *Mucor circinelloides*, a human pathogen, cryptochromes are the protein responsible for DNA repair after exposure to [ultraviolet radiation](#), a function that should be performed by photolyase. They also suggest that cryptochromes in this fungus acquired their ability to repair DNA during evolution from an ancestral cryptochrome that was not able to repair DNA. This discovery illustrates how proteins change as their functions evolve.

The results have been published in an article in *Current Biology*.

[phys.org](#), 14 October 2020

<https://www.phys.org>

New test detects coronavirus in just 5 minutes

2020-10-08

Researchers have used CRISPR gene-editing technology to come up with a test that detects the pandemic coronavirus in just 5 minutes. The diagnostic doesn't require expensive lab equipment to run and could potentially be deployed at doctor's offices, schools, and office buildings.

"It looks like they have a really rock-solid test," says Max Wilson, a molecular biologist at the University of California, Santa Barbara. "It's really quite elegant."

CRISPR diagnostics are just one way researchers are [trying to speed coronavirus testing](#). The new test is the fastest CRISPR-based diagnostic yet. In May, for example, two teams reported creating CRISPR-based

CRISPR tests work by identifying a sequence of RNA—about 20 RNA bases long—that is unique to SARS-CoV-2.

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coronavirus tests that could detect the virus in about an hour, much faster than the 24 hours needed for conventional coronavirus diagnostic tests.

CRISPR tests work by identifying a sequence of RNA—about 20 RNA bases long—that is unique to SARS-CoV-2. They do so by creating a “guide” RNA that is complementary to the target RNA sequence and, thus, will bind to it in solution. When the guide binds to its target, the CRISPR tool’s Cas13 “scissors” enzyme turns on and cuts apart any nearby single-stranded RNA. These cuts release a separately introduced fluorescent particle in the test solution. When the sample is then hit with a burst of laser light, the released fluorescent particles light up, signaling the presence of the virus.

These initial CRISPR tests, however, required researchers to first amplify any potential viral RNA before running it through the diagnostic to increase their odds of spotting a signal. That added complexity, cost, and time, and put a strain on scarce chemical reagents.

Now, researchers led by Jennifer Doudna, who won a share of [this year’s Nobel Prize in Chemistry yesterday](#) for her co-discovery of CRISPR, report creating a novel CRISPR diagnostic that doesn’t amplify coronavirus RNA. Instead, Doudna and her colleagues spent months testing hundreds of guide RNAs to find multiple guides that work in tandem to increase the sensitivity of the test.

In a new preprint, the researchers report that with a single guide RNA, [they could detect as few as 100,000 viruses per microliter of solution](#). And if they add a second guide RNA, they can detect as few as 100 viruses per microliter.

That’s still not as good as the conventional coronavirus diagnostic setup, which uses expensive lab-based machines to track the virus down to one virus per microliter, says Melanie Ott, a senior investigator at the Gladstone Institutes who helped lead the project with Doudna. However, she says, the new setup was able to accurately identify a batch of five positive clinical samples with perfect accuracy in just 5 minutes per test, whereas the standard test can take 1 day or more to return results.

The new test has another key advantage, Wilson says: quantifying a sample’s amount of virus. When standard coronavirus tests amplify the virus’ genetic material in order to detect it, this changes the amount of genetic material present—and thus wipes out any chance of precisely quantifying just how much virus is in the sample.

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By contrast, Ott’s and Doudna’s team found that the strength of the fluorescent signal was proportional to the amount of virus in their sample. That revealed not just whether a sample was positive, but also how much virus a patient had. That information can help doctors tailor treatment decisions to each patient’s condition, Wilson says.

Doudna and Ott say they and their colleagues are now working to validate their test setup and are looking into how to commercialize it.

[sciencemag.org](https://www.sciencemag.org), 8 October 2020

<https://www.sciencemag.org>

France clamps down on use of weedkiller glyphosate in farming

2020-10-09

PARIS (Reuters) - France’s health and environment agency announced restrictions on weedkiller glyphosate in farming, but stopped short of a full ban in the European Union’s top agricultural producer due to a lack of non-chemical alternatives in some areas.

The new rules set out by ANSES on Friday are part of a push by the French government to phase out glyphosate by 2021 and reflect a global debate about the safety of the weedkiller, first developed by Bayer’s Monsanto unit under the brand Roundup.

President Emmanuel Macron in 2017 pledged to end glyphosate use in France within three years, but his government later said it would take into account whether other solutions existed.

In a decision on the main farming and forestry uses of glyphosate, regulator ANSES said the weedkiller would no longer be used in alleys between vines and fruit trees, or in crop fields that are ploughed.

Glyphosate would still be allowed under vines and trees where mechanical weeding was impractical or costly, and would also be permitted on crop farms that avoid ploughing to preserve soil fertility, ANSES said in a statement.

But the maximum amount of glyphosate authorised per year would be reduced by 60% for orchards and crop fields, and 80% for vineyards, it said.

The stricter conditions are to apply within six months for glyphosate products re-approved by ANSES, it added.

President Emmanuel Macron in 2017 pledged to end glyphosate use in France within three years, but his government later said it would take into account whether other solutions existed.

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ANSES has already withdrawn dozens of glyphosate-based weedkillers and is in the process of reviewing those still on the market.

The time needed for reviews may mean some products do not fall immediately under the new rules but remaining renewals should be completed during 2021, Marie-Christine de Guenin, ANSES' head of market authorisations told Reuters.

Non-farm professional uses of glyphosate, like maintenance of railway embankments, would stay permitted in the absence of feasible non-chemical alternatives, but such cases represented only 1.5% of glyphosate use in France, she added.

reuters.com, 9 October 2020

<https://www.reuters.com>

Solar is now 'cheapest electricity in history', confirms IEA 2020-10-13

The world's best solar power schemes now offer the "cheapest...electricity in history" with the technology cheaper than coal and gas in most major countries.

That is according to the International Energy Agency's World Energy Outlook 2020. The 464-page outlook, published today by the IEA, also outlines the "extraordinarily turbulent" impact of coronavirus and the "highly uncertain" future of global energy use over the next two decades.

Reflecting this uncertainty, this year's version of the highly influential annual outlook offers four "pathways" to 2040, all of which see a major rise in renewables. The IEA's main scenario has 43% more solar output by 2040 than it expected in 2018, partly due to detailed new analysis showing that solar power is 20-50% cheaper than thought.

Despite a more rapid rise for renewables and a "structural" decline for coal, the IEA says it is too soon to declare a peak in global oil use, unless there is stronger climate action. Similarly, it says demand for gas could rise 30% by 2040, unless the policy response to global warming steps up.

This means that, while global CO2 emissions have effectively peaked, they are "far from the immediate peak and decline" needed to stabilise the climate. The IEA says achieving net-zero emissions will require "unprecedented" efforts from every part of the global economy, not just the power sector.

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For the first time, the IEA includes detailed modeling of a 1.5C pathway that reaches global net-zero CO2 emissions by 2050. It says individual behaviour change, such as working from home "three days a week", would play an "essential" role in reaching this new "net-zero emissions by 2050 case" (NZE2050).

Future scenarios

The IEA's annual World Energy Outlook (WEO) arrives every autumn and contains some of the most detailed and heavily scrutinised analysis of the global energy system. Over hundreds of densely packed pages, it draws on thousands of datapoints and the IEA's World Energy Model.

The outlook includes several different scenarios, to reflect uncertainty over the many decisions that will affect the future path of the global economy, as well as the route taken out of the coronavirus crisis during the "critical" next decade. The WEO also aims to inform policymakers by showing how their plans would need to change if they want to shift onto a more sustainable path.

This year it omits the "current policies scenario" (CPS), which usually "provides a baseline...by outlining a future in which no new policies are added to those already in place". This is because "[i]t is difficult to imagine this 'business as-usual' approach prevailing in today's circumstances".

Those circumstances are the unprecedented fallout from the coronavirus pandemic, which remains highly uncertain as to its depth and duration. The crisis is expected to cause a dramatic decline in global energy demand in 2020, with fossil fuels taking the biggest hit.

The main WEO pathway is again the "stated policies scenario" (STEPS, formerly NPS). This shows the impact of government pledges to go beyond the current policy baseline. Crucially, however, the IEA makes its own assessment of whether governments are credibly following through on their targets.

The report explains:

"The STEPS is designed to take a detailed and dispassionate look at the policies that are either in place or announced in different parts of the energy sector. It takes into account long-term energy and climate targets only to the extent that they are backed up by specific policies and measures. In doing so, it holds up a mirror to the plans of today's policy makers and illustrates their consequences, without second-guessing how these plans might change in future."

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The outlook then shows how plans would need to change to plot a more sustainable path. It says its “sustainable development scenario” (SDS) is “fully aligned” with the Paris target of holding warming “well-below 2C... and pursuing efforts to limit [it] to 1.5C”. (This interpretation is [disputed](#).)

The SDS sees CO2 emissions reach net-zero by 2070 and gives a 50% chance of holding warming to 1.65C, with the potential to stay below 1.5C if [negative emissions](#) are used at scale.

The IEA has not previously set out a detailed pathway to staying below 1.5C with 50% probability, with last year’s outlook only offering background analysis and some broad [paragraphs of narrative](#).

For the first time this year, the WEO has “detailed modelling” of a “net-zero emissions by 2050 case” (NZE2050). This shows what would need to happen for CO2 emissions to fall to 45% below 2010 levels by 2030 on the way to net-zero by 2050, with a 50% chance of meeting the [1.5C limit](#).

The final pathway in this year’s outlook is a “delayed recovery scenario” (DRS), which shows what might happen if the coronavirus pandemic lingers and the global economy takes longer to recover, with knock-on reductions in the growth of GDP and energy demand.

The chart below shows how the use of different energy sources changes under each of these pathways over the decade to 2030 (right-hand columns), relative to demand today (left).

Notably, renewables (light green) account for the majority of demand growth in all scenarios. In contrast, fossil fuels see progressively weaker growth turn to increasing declines, as the ambition of global climate policy increases, from left to right in the chart above.

Intriguingly, there are signs that the IEA has been giving greater prominence to the SDS, a pathway aligned with the “well-below 2C” Paris goal. In the WEO 2020, it features more frequently, earlier in the report, and more consistently through the pages, compared with earlier editions.

This is shown in the chart below, which shows the location, by relative page position, of each mention of “sustainable development scenario” or “SDS” in the WEOs published over the past four years.

Solar surge

One of the most significant shifts in this year’s WEO is tucked away in Annex B of the report, which shows the IEA’s estimates of the cost of different electricity generation technologies.

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The table shows that solar electricity is some 20-50% cheaper today than the IEA had estimated in last year’s outlook, with the range depending on the region. There are similarly large reductions in the estimated costs of onshore and offshore wind.

This shift is the result of new analysis carried out by the WEO team, looking at the average “[cost of capital](#)” for developers looking to build new generating capacity. Previously the IEA assumed a [range of 7-8%](#) for all technologies, varying according to each country’s stage of development.

Now, the IEA has reviewed the evidence internationally and finds that for solar, the cost of capital is much lower, at 2.6-5.0% in Europe and the US, 4.4-5.5% in China and 8.8-10.0% in India, largely as a result of policies designed to reduce the risk of renewable investments.

In the best locations and with access to the most favourable policy support and finance, the IEA says the solar can now generate electricity “at or below” \$20 per megawatt hour (MWh). It says.

The IEA says that new utility-scale solar projects now cost \$30-60/MWh in Europe and the US and just \$20-40/MWh in China and India, where “revenue support mechanisms” such as guaranteed prices are in place.

These costs “are entirely below the range of LCOE [levelised costs] for new coal-fired power plants” and “in the same range” as the operating cost of existing coal plants in China and India, the IEA says. This is shown in the chart below.

Onshore and offshore wind are also now assumed to have access to lower-cost finance. This accounts for the much lower cost estimates for these technologies in the latest WEO, because the cost of capital contributes up to half of the cost of new renewable developments.

When combined with changes in government policy over the past year, these lower costs mean that the IEA has again raised its outlook for renewables over the next 20 years.

This is shown in the chart below, where electricity generation from non-hydro renewables in 2040 is now seen reaching 12,872 terawatt hours (TWh) in the STEPS, up from 2,873TWh today. This is some 8% higher than expected last year and 22% above the level expected in 2018’s outlook.

Solar is the largest reason for this, with output in 2040 up 43% compared with the 2018 WEO. In contrast, the chart shows how electricity generation from coal is now “structurally” lower than previously expected, with output

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in 2040 some 14% lower than thought last year. The fuel never recovers from an estimated 8% drop in 2020 due to the coronavirus pandemic, the IEA says.

Notably, the level of gas generation in 2040 is also 6% lower in this year's STEPS, again partly as a result of the pandemic and its long-lasting impact on economic and energy demand growth.

Overall, renewables – led by the “new king” solar – meet the vast majority of new electricity demand in the STEPS, accounting for 80% of the increase by 2030.

This means they overtake coal as the world's largest source of power by 2025, outpacing the “accelerated case” set out by the agency just a year ago.

The rise of variable renewable sources means that there is an increasing need for electricity grid flexibility, the IEA notes. “Robust electricity networks, dispatchable power plants, storage technologies and demand response measures all play vital roles in meeting this,” it says.

Revised outlooks

The lower costs and more rapid growth for solar seen in this year's outlook means there will be record-breaking additions of new solar capacity in every year from 2020, the IEA says.

This contrasts with its STEPS pathway for solar in previous years, where global capacity additions each year – net of retirements – have flatlined into the future.

Now, solar growth rises steadily in the STEPS, as shown in the chart below (solid black line). This is even clearer if accounting for new capacity being added to replace old solar sites as they retire (gross, dashed line). Under the SDS and NZE2050, growth would need to be even faster.

The story of raised outlooks for solar – thanks to updated assumptions and an improving policy landscape – is directly contrasting with the picture for coal.

Successive editions of the WEO have revised down the outlook for the dirtiest fossil fuel, with this year seeing particularly dramatic changes, thanks in part to a “structural shift” away from coal after coronavirus.

The IEA now sees coal use rising marginally over the next few years, but then going into decline, as shown in the chart below (red line).

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Nevertheless, this trajectory falls far short of the cuts needed to be in line with the SDS, a pathway aligned to the “well-below 2C” Paris target (yellow).

This year's outlook makes particularly drastic changes for India, where the use of coal in electricity generation is seen growing far more slowly than expected last year.

In the STEPS, coal-fired power capacity would grow by just 25 gigawatts (GW) by 2040, the IEA says, which is 86% less than expected in the WEO 2019. Rather than nearly doubling in size from 235GW in 2019, this means that India's coal fleet would barely grow over the next two decades.

Similarly, growth in the amount of electricity generated from coal in India is now expected to be 80% slower than thought last year, according to the IEA figures.

The IEA expects continued rapid retirements of old coal capacity in the US and Europe, which would by 2040 close 197GW (74% of the current fleet) and 129GW (88%) respectively.

Taken together, and despite a rapid expansion in southeast Asia, this means the outlook – for the first time – sees the global coal fleet shrinking by 2040.

Energy outlook

Taken together, the rapid rise of renewable energy and the structural decline for coal help keep a lid on global CO₂ emissions, the outlook suggests. But steady demand for oil and rising gas use mean CO₂ only flattens off, rather than declining rapidly as required to meet global climate goals.

These competing trends are shown in the chart, below, which tracks primary energy demand for each fuel under the IEA STEPS, with solid lines. Overall, renewables meet three-fifths of the increase in energy demand by 2040, while accounting for another two-fifths of the total. Smaller increases for oil and nuclear are enough to offset the decline in coal energy use.

The dashed lines in the chart above show the dramatically different paths that would need to be followed to be in line with the IEA SDS, which is roughly a well-below 2C scenario.

By 2040, although oil and gas would remain the first and second-largest sources of primary energy, there would have been declines in the use of all

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fossil fuels. Coal would have dropped by two-thirds, oil by a third and gas by 12%, relative to 2019 levels.

Meanwhile, other renewables – primarily wind and solar – would have surged to third place, rising nearly seven-fold over the next two decades (+662%). The SDS sees smaller, but still sizeable increases for hydro (+55%), nuclear (+55%) and bioenergy (+24%).

Together, low-carbon sources would make up 44% of the global energy mix in 2040, up from 19% in 2019. Coal would fall to 10%, its lowest since the industrial revolution, according to the IEA.

Despite these rapid changes, however, the world would not see net-zero CO2 emissions until 2070, some two decades after the 2050 deadline that would be needed to stay below 1.5C.

This is despite the SDS including “full implementation” of the net-zero targets set by the UK, EU and most recently China.

(These targets would be only partially implemented under the STEPS, based on the IEA’s assessment of the credibility of the policies in place to meet the goals. For example, table B.4 of the report says that under the STEPS, there is only “some implementation” of the UK’s legally binding target to reach net-zero greenhouse gas emissions by 2050.)

Net-zero numbers

The NZE2050 “case”, describing a route to 1.5C, has been published for the first time this year, because the WEO team agreed “it was time to deepen and extend our analysis of net-zero emissions”, according to IEA director Fatih Birol, writing in the report’s foreword.

Over the past 18 months, major economies announcing or legislating net-zero emissions targets include the UK and EU. Most recently, China announced its intention to reach “carbon neutrality” by 2060. [Forthcoming analysis for Carbon Brief will explore the implications of this goal.]

Carbon Brief analysis of the last four WEOs shows that these developments – along with the publication of the Intergovernmental Panel on Climate Change (IPCC) special report on 1.5C in 2018 – have been accompanied by a significant uptick in coverage of these topics in the WEO.

Whereas the WEO 2017 used the phrase “1.5C” less than once per 100 pages, this increased to five uses in 2019 and eight uses per 100 pages in

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2020. The usage of “net zero” is up from once per 100 pages in 2017 and 2018, to six in 2019 and 38 per 100 pages in this year’s report.

However, the NZE2050 case is not a full WEO scenario and so it does not come with the full set of data that accompanies the STEPS and SDS, making it difficult to fully explore the pathway.

This seems “bizarre”, says Dr Joeri Rogelj, a lecturer in climate change and the environment at the Grantham Institute at Imperial College London and a coordinating lead author of the IPCC 1.5C report.

The IEA already publishes lengthy annexes, with detailed information on the pathway for different energy sources and CO2 emissions from each sector, in a range of key economies around the world, under each of its main scenarios. (This year these are the STEPS and SDS.)

Rogelj, who last year joined scientists and NGOs calling for the IEA to publish a full 1.5C scenario, tells Carbon Brief that “all underlying data of the NZE2050 case should be made available with the same detail as the other WEO scenarios”.

Carbon Brief has asked the IEA for such data and will update this article if more details emerge. Rogelj adds:

“The main question, of course, is how the NZE2050 intends to reach its objective of net-zero CO2 emissions in 2050. Of particular interest here is how much and which type of CO2 removal [negative emissions] the scenario intends to use and how it intends to do so while ensuring sustainable development.”

The WEO devotes a full chapter to the NZE2050, with a particular emphasis on the changes that would be needed over the next decade to 2030.

(It also compares the pathway to those set out in the IPCC special report, saying that the NZE2050 case has a comparable CO2 emissions trajectory to the “P2” scenario, which stays below 1.5C with “no or low overshoot” and has relatively “limited” use of BECCS.)

The chart below shows how CO2 emissions effectively plateau to 2030 in the STEPS, remaining just below the level seen in 2019, whereas the NZE2050 case sees a decline of more than 40%, from 34bn tonnes (GtCO2) in 2020 to just 20GtCO2 in 2030.

The power sector contributes the largest portion of the savings needed over the next decade (orange wedges in the chart, above). But there are also important contributions from energy end-use (yellow), such as

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transport and industry, as well as from individual behaviour change (blue), explored in more detail in the next section.

These three wedges would contribute roughly equal shares of the extra 6.4GtCO₂ of savings needed to go from the SDS to the NZE2050 in 2030, the IEA says.

The NZE2050 case would see low-carbon sources of electricity meeting 75% of demand in 2030, up from 40% today. Solar capacity would have to rise at a rate of around 300 gigawatts (GW) per year by the mid-2020s and nearly 500GW by 2030, against current growth of around 100GW.

CO₂ emissions from coal-fired power stations would decline by 75% between 2019 and 2030. This means the least efficient “subcritical” coal plants would be phased out entirely and the majority of “supercritical” plants would also close down. The WEO says the majority of this decline would come in southeast Asia, which accounts for two-thirds of current global coal capacity.

Although nuclear would contribute a small part of the increase in zero-carbon generation by 2030 in the NZE2050, the IEA notes that the “long lead time of large-scale nuclear facilities” limits the technology’s potential to scale more quickly this decade.

For industry, CO₂ emissions would fall by around a quarter, with electrification and energy efficiency making up the largest shares of the effort. More than 2m homes would get an energy efficiency retrofit during every month this decade, in “advanced economies” alone.

In the transport sector, CO₂ would fall by a fifth, not including behavioural shifts counted below. By 2030, more than half of new cars would be electric, up from around 2.5% in 2019.

Behavioural changes

For the first time, this year’s outlook contains a detailed analysis of the potential for individual behaviour change to reduce CO₂ emissions. (This is clear even at a simplistic level, with the word “behaviour” mentioned 122 times, against just 12 times in 2019.)

Behavioural shifts, such as cutting down on flights and turning down air conditioning, will play a vital role in achieving net-zero emissions, according to the report.

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While the SDS calls for modest changes to people’s lifestyles, such as increased use of public transport, these choices only make up 9% of the difference between that scenario and the STEPS.

By comparison, in the NZE2050 these changes are responsible for nearly a third of the CO₂ reductions relative to the SDS in 2030.

The report includes a detailed analysis of estimated emissions savings from the global adoption of specific actions, including a global switch to line-drying laundry, slower driving speeds and working from home.

The authors estimate that 60% of these changes could be influenced by governments, citing widespread legislation to control car use in cities and Japan’s efforts to limit air conditioning in homes and offices.

As the chart below shows, changes to people’s transport choices account for the majority of the emissions savings. Road transport (blue bars) accounts for more than half the savings in 2030 and significantly reducing the number of flights accounts for another quarter (yellow).

Around 7% of CO₂ emissions from cars come from trips of less than 3km, which “would take less than about 10 minutes to cycle”, according to the authors. In the NZE2050 scenario, all of these trips are replaced with walking and cycling.

The report estimates that behaviour shifts could cut emissions from flying by around 60% in 2030. These include substantial changes, such as eliminating flights of less than one hour long, as well as reducing numbers of both long-haul and business flights by three quarters.

Even so, due to the growth in aviation that is otherwise expected, total aviation activity in 2030 would still remain around 2017 levels in this scenario.

The remaining savings come from decisions to limit the use of energy in homes, such as turning both heating and air conditioning systems down.

Working from home has the potential to save emissions overall, as the reduction in emissions from commuting is more than three times larger than the increase in residential emissions.

The report estimates that if the 20% of the global workforce who are able to work from home did so for just one day a week, in 2030 this would save around 18m tonnes of CO₂ (MtCO₂) globally, as the chart below shows.

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In fact, the NZE2050 scenario assumes that all those who are able to do so, work from home three days a week, amounting to a relatively modest 55MtCO₂ savings.

Due to wider changes in the energy mix in NZE2050, the emissions impact of widespread home working is small when compared to the current situation, shown in the left-hand column, or STEPS in 2030, shown in the middle column.

While the report focuses on CO₂ emissions from the energy system, it also alludes to the high levels of methane and nitrous oxide resulting from global agriculture and livestock farming in particular.

It notes that without shifts towards vegetarian diets it will be “very difficult to achieve rapid emissions reductions”.

The authors acknowledge that universal adoption of the proposed behaviour changes is unlikely, but suggest there are “alternative ways” in which such changes could combine to yield similar results.

For example, though some regions may not introduce tougher speed limits, others might decide to cut driving speeds by more than the 7km/h suggested in the report.

carbonbrief.org, 13 October 2020

<https://website>

Stan the T. rex sells for record \$32 million at auction

2020-10-07

An unusually complete *Tyrannosaurus rex* fossil has sold for a record-breaking \$31.8 million at an auction that has dismayed many paleontologists.

The specimen, officially called BHI 3033, is popularly known as Stan, after its discoverer, amateur paleontologist Stan Sacrison, who found it in 1987 in the Hell Creek Formation near the town of Buffalo, South Dakota. The fossil has been located at the Black Hills Institute of Geological Research.

The sale price dwarfs the \$8.36 million the Field Museum of Natural History paid in 1997 for the *T. rex* fossil named Sue. The buyer of Stan has not been identified, [The New York Times reports](#).

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Paleontologists worry such sales will encourage more private trade of fossils, leaving important specimens off-limits to researchers. The Society of Vertebrate Paleontology wrote to the auction company Christie's in September asking it to restrict the sale to “institutions committed to curating specimens for the public good and in perpetuity, or those bidding on behalf of such institutions.”

sciencemag.org, 7 October 2020

<https://www.sciencemag.org>

After 3,000 years, Tasmanian devils return to mainland Australia

2020-10-08

The pitter-patter of Tasmanian devil feet was heard in the wild of mainland Australia for the first time in 3,000 years, after a group of devils was released in Barrington Tops, a protected national park about 120 miles (200 kilometers) north of Sydney.

Tasmanian devils (*Sarcophilus harrisii*), the world's largest carnivorous marsupial, have been long gone from most of the Australian continent, and until now the only remaining wild populations were on the island of Tasmania. Mainland devils were likely outcompeted by dingos, the wild dogs that were introduced to Australia at least 3,500 years ago, and which are now considered a pest species.

However, a decade of dingo eradication has offered Tasmanian devils a second chance. By clearing out dingos and reintroducing devils to Barrington Tops, conservationists hope to not only reestablish thriving wild populations of the iconic marsupials, but to also help protect other native species that are threatened by invasive predators, according to a statement released on Oct. 5 by Global Wildlife Conservation (GWC).

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Aussie Ark, a wildlife nonprofit in Australia, has been breeding and studying Tasmanian devils for more than a decade, with the goal of eventually reintroducing devils into the wild once conditions were sustainable for their survival, according to the statement. For the recent release, Aussie Ark partnered with GWC and WildArk, another wildlife conservation nonprofit; they released 11 Tasmanian devils on Sept. 10.

Tasmanian devils are black-furred and stocky with blunt muzzles and short limbs, measuring about 22 to 26 inches (55 to 65 centimeters) long

However, a decade of dingo eradication has offered Tasmanian devils a second chance.

The buyer of Stan has not been identified, The New York Times reports.

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and standing about 12 inches (30 cm) high at the shoulder, according to the [Australian Museum](#). Devils on the island of Tasmania were safe from dingos, which never got a foothold there. But Tasmania's devils face another deadly threat: a highly contagious and fatal [cancer](#) known as [devil facial tumor disease](#) (DFTD). First detected in the 1990s, the cancer has since wiped out about 90% of Tasmania's devils, leaving only 25,000 in the wild, according to the GWC statement.

Conservation experts in Tasmania work to isolate healthy devils from sick ones, and to breed healthy populations. But there are limited opportunities on the island for reintroducing the healthy devils and keeping them separated from infected devils, "and it's impossible as yet to eradicate the disease," GWC president Don Church told Live Science.

Because the cancer only spreads through direct facial contact between devils — usually when they nip each other's faces while competing over prey — a cancer-free devil population on Australia's mainland would therefore be safe from infection, Church said.

Bringing Tasmanian devils back to the Australian continent could also help address another dire ecological threat posed by domestic cats and [foxes](#); neither species is native to the continent, and both were introduced to Australia in the 18th century by European colonizers. Dingos once helped keep cat and fox populations somewhat under control, but as dingos were eradicated over the last decade, the number of cats and foxes has skyrocketed — and their impact on native wildlife is devastating. Cats in Australia kill more than 2 billion wild animals each year; in just one day, Australia's millions of cats kill an estimated 1.3 million birds, 1.8 million reptiles and over 3.1 million mammals, [Live Science](#) previously reported.

But introducing devils might deter these invasive predators or disrupt their hunting habits, Church said.

"In the presence of devils, cats are less able to hunt at night, because devils are nocturnal," he explained. "So they shift to hunt during the day, and they're not as effective when they hunt during the day."

As for foxes, European colonizers tried to introduce them to Tasmania at least six times and failed every attempt — possibly because Tasmanian devils were already established there.

"There was never a scientific study done as to why it never took — the habitat seemed perfect for them, the prey was there," Church said. But one

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hypothesis is that the presence of the Tasmanian devil prevented foxes from gaining a foothold.

Though Tasmanian devils are carnivorous, they would be less detrimental to native biodiversity than cats or foxes because devils are marsupials. As such, they have a lower metabolic rate than placental carnivores, and don't need to eat as often, Church said. Devils also prefer to eat animals that are already dead, which further reduces their impact on an ecosystem's resources, he added.

"That Barrington Tops area has about 40 species that we know of that are in trouble," Church said. "Our hope is that the presence of the devils will be an ecological solution, a contribution to addressing the main driver of extinction on the Australian continent, which is the presence of feral cats and foxes. We hope long-term that the presence of the devil on the landscape will help keep the numbers of those introduced species at bay, and it'll be a natural, self-replicating solution to the problem."

After a few weeks, scientists will recapture some of the released devils and fit them with radio transmitter harnesses; the animals can't wear collars because "they don't really have a neck," Church said. Surveys and camera traps will provide additional data on how the devils are adapting to their new home. But the real proof of their success will arrive around June 2021, if new devil joeys are spotted peeping out of their mothers' pouches, Church told Live Science.

"That'll be a great indicator that the population can survive on its own," he said.

Originally published on Live Science.

[livescience.com](#), 8 October 2020

<https://www.livescience.com>

Warming has killed half the coral on the Great Barrier Reef, study finds. It might never recover.

2020-10-14

Half of the coral populations on Australia's Great Barrier Reef — from "big mamas" to the little baby coral they spawn — have been wiped out in the warming ocean, a new study says.

Studying coral as if it were a residential demographic, and counting its abundance over 30 years starting in 1995, four Australian researchers

"These were the worst affected by record breaking temperatures that triggered mass bleaching in 2016 and 2017."

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determined that size didn't matter when bleaching events, such as two that occurred in recent back-to-back years, strike the giant reef.

"The decline occurred in both shallow and deeper water, and across virtually all species — but especially in branching and table-shaped corals," Terry Hughes, a professor at the ARC Center of Excellence for Coral Reef Studies in Queensland and a co-author of the research paper, said in a statement Tuesday. "These were the worst affected by record breaking temperatures that triggered mass bleaching in 2016 and 2017."

On some areas of the northern half of the reef, "the abundance of large colonies on the crest dropped" by up to 98 percent, according to the study, published in the journal *Proceedings of the Royal Society B*. By contrast, there was a slight increase on the southern slope, about 25 percent.

It's a clear sign of rapid decline.

"We expect this decline to continue" because of warming caused by humans, Hughes said. "The only effective way to improve the outcome for coral reefs is global action on greenhouse gasses. If global temperatures rise to 3 or 4 [degrees Celsius], the reef will be unrecognizable, so there is no time to lose."

"We have evidence from some parts of the reef that recruitment rates are only recovering very slowly ... and are nowhere near levels prior to the bleaching events," Andreas Dietzel, another professor at the ARC Center and a co-author of the paper, said in an email.

Coral that spawn the larvae that makes more coral "have declined dramatically over vast stretches of the Great Barrier Reef," Dietzel said. "It will therefore take time for reproduction to recover. Corals are tremendously resilient because of their capacity to produce millions of babies but they/we desperately need a break from disturbances."

The Great Barrier Reef is incredibly important to Australia. Before the coronavirus pandemic, more than 2 million tourists traveled to Queensland each year from all over the world to experience its color and biodiversity. Worldwide, reefs provide habitat for a quarter of marine animals and plants, coastal protection that limits flooding for 500 million residents, and fishing that provides protein and revenue, according to the Sydney Institute of Marine Science.

The institute and the University of Sydney recently partnered to develop an experimental technology called marine cloud brightening to offset bleaching events that kill coral. It's a Hail Mary attempt to block sunlight

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and reflect it back to the sky to limit warming and higher rates of ocean acidification that cause mass mortality on the reef.

But that extreme measure, combined with other actions such as limiting reef fishing, might not be enough for a country that continues to lead the world in exporting coal, a fossil fuel that contributes to warming, which hastens the decline of coral, experts say.

"Our results show the ability of the Great Barrier Reef to recover — its resilience — is compromised compared to the past, because there are fewer babies, and fewer large breeding adults," Dietzel said.

Bob Richmond, a research professor and director of the Kewalo Marine Laboratory at the University of Hawaii at Manoa, called the study "a really excellent piece of work," with the most comprehensive research on Great Barrier Reef coral populations that he's seen.

"What they're showing is these demographic changes are occurring on a regional scale ... on reef slopes that make it difficult for coral reefs to persist over time," Richmond said. In his long experience of visiting and researching reefs around the world, "if I don't see one-year-old, two-year-old, three-year-old corals, I know that reef is dead. It just doesn't know it yet."

As the population declines, the distance between coral formations increases, limiting their ability to reproduce. "These bleaching events are just hammering these reefs. This is just a really bad time and a really bad combination," Richmond said.

Although half of the Great Barrier Reef's loss of abundance happened over three decades, Richmond said the world doesn't have three more decades before the rest potentially disappears.

"The problem is it's an accelerated loss," he said. "It's hard to have a crystal ball and say a date. Scientists are always trying to be careful, but if we don't act meaningfully in the next five years, we will not have vital and vibrant coral reefs as a legacy for future generations."

There is hope in Australia and other reef formations around the world, such as in Indonesia, said Gabby Ahmadi, director of ocean science at the World Wildlife Fund. Some coral is developing a resistance to rising temperatures and even acidification.

"The reality of the situation is that coral reefs are declining around the world, but the hope is we can have better local solutions to overfishing,

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runoffs from land and farming practices,” Ahmadiya said. “They are going to decline, no doubt, but we can conserve what’s left.”

Ahmadiya looks at coral reef conservation as if it were a management portfolio, with high and low risks. Reducing pollution and fish harvests on reefs is a reliable, low-risk solution for governments to consider. At the high end are attempts to harden reefs in labs and desperate heaves such as blocking sunlight and cooling water.

“We work in Indonesia and reefs haven’t been hit as hard there,” Ahmadiya said optimistically. The peril faced by coral “really varies,” she said. “There are a lot of studies predicting the future. I don’t think we know.”

But her optimism only goes so far if aggressive action isn’t taken.

“A lot of people say 90 percent of the coral loss will happen by 2050,” she said.

washingtonpost.com, 14 October 2020

<https://www.washingtonpost.com>

Scarlet fever is making a comeback. Bacterial ‘clone’ could be to blame

2020-10-08

Once a leading cause of death for children across the western world, scarlet fever was nearly eradicated thanks to 20th century medicine. But fresh outbreaks in the UK and North East Asia over recent years suggest we’ve still got a long way to go.

Just why we’re experiencing a resurgence of the deadly pathogen is a mystery. A new study has uncovered clues in the genome of one of the bacterial strains responsible, showing just how complex the family tree of infectious diseases can be.

The species behind the illness is group A strep, or *Streptococcus pyogenes*; a ball-shaped microbe that can churn out toxic compounds called superantigens, capable of wreaking havoc inside the body. Especially in children.

PLAY SOUND

The results can be as mild as an uncomfortable case of pharyngitis or a bad rash, or as severe as a toxic shock that causes organs to fail.

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With the advent of antibiotics, outbreaks could easily be managed before they got out of hand. By the 1940s, the disease was well on the way out.

That all looks to be changing.

“After 2011, the global reach of the pandemic became evident with reports of a second outbreak in the UK, beginning in 2014, and we’ve now discovered outbreak isolates here in Australia,” says University of Queensland molecular biologist Stephan Brouwer.

“This global re-emergence of scarlet fever has caused a more than five-fold increase in disease rate and more than 600,000 cases around the world.”

Leading an international team of researchers in a study on group A strep genes, Brouwer has been able to characterize a variety of superantigens produced by one particular strain from North East Asia.

Among them was a kind of superantigen that appears to give the bacterial invaders a clever new way to gain access to the insides of the host’s cells, one never seen before among bacteria.

Its novelty implies that these outbreaks aren’t descended from the same strains of bacteria that have rippled through communities in centuries past. Rather, they’re closely related populations of group A strep that learned a new trick or two on their own.

One way similar organisms can evolve the same characteristics – such as advanced virulence – is for natural selection to independently fine-tune shared genes in the same way.

But other studies have already suggested this strain of bacterium received a helping hand in the form of an infection of their own, one from a type of virus called a phage.

“The toxins would have been transferred into the bacterium when it was infected by viruses that carried the toxin genes,” says bioscientist Mark Walker, also from the University of Queensland.

“We’ve shown that these acquired toxins allow *Streptococcus pyogenes* to better colonize its host, which likely allows it to out-compete other strains.»

In a process known as horizontal gene transfer, a gene that evolved in one microbe can be incorporated into a virus’s genome and edited into a new host’s DNA, creating a kind of clone of the original.

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Though hardly limited to bacteria, it is a quick and handy way for single-celled microbes to adapt. Such stolen genes can provide pathogens with new ways to gain entry to host tissues, or resist the chemical warfare that would otherwise keep them at bay.

In this case, it has helped a less serious strain of bacteria to develop a weapon that makes it as concerning as its vanquished cousin.

To double check the acquired superantigen's importance, the researchers used genetic editing to disable their coding. As a result, the strains lost their knack for colonizing the animal models used to test the bacteria's virulence.

For now, our management of an even bigger threat seems to be containing the most recent scarlet fever outbreaks. Spread through aerosols much like SARS-CoV-2, group A strep is unlikely to become an epidemic under current restrictions.

"But when social distancing eventually is relaxed, scarlet fever is likely to come back," says Walker.

"Just like COVID-19, ultimately a vaccine will be critical for eradicating scarlet fever – one of history's most pervasive and deadly childhood diseases."

This research was published in [Nature Communications](#).

[livescience.com](#), 8 October 2020

<https://www.livescience.com>

Fertiliser use is fueling climate-warming nitrous oxide emissions: study

2020-10-08

LONDON (Reuters) - The rising use of nitrogen-based fertilisers is driving up global emissions of nitrous oxide, a lesser-known greenhouse gas, complicating efforts to limit climate change, scientists reported in a study on Wednesday.

Most of the focus in curbing climate-warming gas emissions has focused on the most abundant, carbon dioxide, and one of the most potent, methane, with the fossil fuel industry under pressure to drastically curtail both.

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But nitrous oxide (N₂O), also known as "laughing gas" or simply "nitrous," has received less attention as a long-lasting warming agent.

"There's much less policy attention on nitrous oxide, and not so many mitigation options, so the emissions just continue sailing on upwards," study co-author Glen Peters, a climate scientist at the Oslo-based CICERO Center for International Climate Research, told Reuters "It makes meeting climate targets even more challenging."

For the five-year study, published in the journal *Nature*, scientists at 48 institutions around the world measured and calculated both natural and human-caused N₂O emissions from 1980 to 2016.

They found that N₂O emissions from agriculture rose annually by 1.4% on average over those 36 years. Agriculture accounts for more than half of human-caused N₂O emissions.

While nitrogen fertilisers have been crucial to boosting crop productivity and improving food security worldwide, they also can cause environmental challenges. Nitrogen in agricultural run-off can feed algae blooms that create coastal dead zones. And in the stratosphere, N₂O can break down to form other molecules that destroy the ozone layer protecting the planet from ultraviolet radiation.

As a climate pollutant, N₂O can linger in the atmosphere for decades, and is far more efficient than CO₂ in trapping heat.

More efficient use of fertilisers could help bring down emissions, the authors wrote. They also urged efforts to curb deforestation, which can increase the amount of N₂O produced by soil bacteria.

[reuters.com](#), 8 October 2020

<https://www.reuters.com>

Agriculture accounts for more than half of human-caused N₂O emissions.

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What does COVID-19 vaccine efficacy mean?

2020-10-04

With several vaccines against COVID-19 in late-phase testing, the business of measuring efficacy is front and center.

Determining the efficacy, or how well a vaccine works in a randomized, controlled trial, gives a sense of how much a vaccine could help alleviate the suffering caused by COVID-19. The U.S. Food and Drug Administration recommends vaccines tested against COVID-19 reach an efficacy of 50 percent, at minimum. That means at least a 50 percent reduction in cases of COVID-19 disease in those who are vaccinated compared with those who receive the placebo.

Johnson & Johnson, Moderna, Pfizer and AstraZeneca have each begun phase III trials of their vaccines in the United States. These late-phase trials, which will each assess safety and efficacy in tens of thousands of people, randomly assign some participants to receive vaccinations and others a placebo. The companies and the U.S. government, working together as part of Operation Warp Speed, have set a goal of having initial doses of a vaccine available by January 2021 (*SN*: 7/10/20). It won't be clear how well any of these vaccines do their job until the companies report full results from those trials; some preliminary results may come out as early as October.

The FDA setting a minimum recommendation for efficacy doesn't mean vaccines couldn't perform better. The benchmark is also a reminder that COVID-19 vaccine development is in its early days. If the first vaccines made available only meet the minimum, they may be replaced by others that prove to protect more people. But with more than 1 million deaths from COVID-19 worldwide — and U.S. deaths surpassing 200,000 — the urgency in finding a vaccine that safely helps at least some people is at the forefront.

"You want to set the bar [for efficacy] high enough so that it is clinically and epidemiologically significant, but low enough that a 'good enough' vaccine can be licensed until something better comes along," says Kawsar Talaat, a vaccine researcher at the Johns Hopkins Bloomberg School of Public Health.

The World Health Organization has also set a minimum target of 50 percent efficacy for vaccines tested against COVID-19, but its "preferred efficacy" is at least 70 percent.

The U.S. Food and Drug Administration recommends vaccines tested against COVID-19 reach an efficacy of 50 percent, at minimum.

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Efficacy specifically applies to how a vaccine works in a clinical trial. For the four vaccine candidates now in phase III trials in the United States, the primary goal is not necessarily to stop an infection but to prevent a person from experiencing symptoms of COVID-19 or, in Johnson & Johnson's case, to guard against moderate to severe illness. Researchers will count cases of symptomatic COVID-19 in the vaccinated group and in the placebo group (who get injections of saline, for example) and calculate how much of a reduction there was with vaccination.

"At least with the first generation of vaccines," Talaat says, "what we're really trying to do is prevent severe disease and hospitalization and death."

A vaccine that prevents people from developing symptoms may not stop them from becoming infected and passing the virus to others. If such a vaccine gets approved, what the vaccine does and doesn't do would need to be communicated very clearly, says Maria Bottazzi, a vaccinologist at the Baylor College of Medicine in Houston. People would still need to wear masks and practice social distancing to help keep the virus from spreading, she says.

The efficacy results won't be the final word on how effective the vaccine is in the real world. That's one reason "why it's always a good idea to have a more diverse population in your trials," says Saad Omer, a vaccine researcher at Yale University. That way, researchers can gather data on how the vaccine works for different people in a variety of scenarios.

Studies of other vaccines in which a trial took place in different locations have reported different results based on the incidence of disease in those areas; some vaccines haven't worked as well in populations where the risk of exposure is higher. In this pandemic, Black and Latino Americans are disproportionately represented in the essential jobs that can't be done at home, putting them at risk for more exposures to the coronavirus (*SN*: 7/2/20).

A person's age also affects how well a vaccine will work. Our immune system "ages as we age too," says Bottazzi. When older adults get the flu vaccine, for example, the shot doesn't elicit as strong an immune response as it does in younger adults. In the United States, adults ages 65 and older can get specially formulated flu vaccines that create a stronger immune response and better protection for this age group.

For the COVID-19 vaccine trials, the FDA has strongly encouraged "enrollment of populations most affected by COVID-19, specifically racial and ethnic minorities." The agency also states that the phase III trials

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should include enough older adults and people with certain underlying medical conditions, two groups at increased risk for COVID-19, to be able to evaluate efficacy for them.

How well the first COVID-19 vaccines work, and for whom, will influence who is initially prioritized to receive the vaccine. The Advisory Committee on Immunization Practices of the U.S. Centers for Disease Control and Prevention issues guidance on the use of vaccines in the general population. To recommend a COVID-19 vaccine for older adults, for example, there has to be data to show that it works for them.

There are other COVID-19 vaccines in development and testing; some aren't very far behind the front runners. Even if one or more of the vaccines now in phase III trials gets the green light, "the story wouldn't be over," says Omer. "It would be the end of the beginning."

sciencenews.org, 4 October 2020

<https://www.sciencenews.org>

An oddity in your forearm proves humans aren't done evolving yet

2020-10-12

Just when you thought we had this whole being-a-human thing figured out, we're apparently still changing in irreversible ways. In a new paper, scientists have identified a feature they say is actively evolving in the human forearm.

Everything in nature is always in some state of evolution, but it's very hard to see in realtime because of how long the time scales are outside of isolated examples like the birds of the Galapagos Islands or scientific studies of fruit flies. In the new research, experts identify different kinds of human forearms: some people have something called the *median artery*, and some people don't ... yet.

The scientists, based in different schools in Australia, studied human remains for the presence of the median artery. "A total of 26 median arteries were found in 78 upper limbs obtained from Australians aged 51 to 101 years, who died in the period 2015–2016, a prevalence rate of 33.3 [percent]," they explain in the paper:

"Second-order polynomial regression of the median artery's prevalence on dates of birth shows that it is now present in 35 [percent] of people and predicts that people born 80 years from now will all carry a median artery

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if the trend continues. When the median artery prevalence reaches 50 percent or more, it should not be considered as a variant, but as a 'normal' human structure."

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There are other qualities that are divided in this way, which scientists speculate have to do with ongoing evolution especially of human groups that came from geographically separated groups—think varying lactose tolerance, an interesting selective allergic reaction to alcohol, and other very minor characteristics.

But for a physical structure in the body to be different is much more uncommon, and even physiognomist favorites like "the bump at the base of the skull" don't follow the population guidelines they insist are true.

This content is imported from YouTube. You may be able to find the same content in another format, or you may be able to find more information, at their web site.

The median artery forms in quite young fetuses in the womb, and as with lactose tolerance, it eventually disappears in most people. This is the key fact that scientists say is changing. They describe the median artery in adults as the *persistent* median artery referring to the survival past fetal development.

Persistent median arteries come in two flavors so far, named for how far they radiate down into the forearm and sometimes the hand. "Two main phenotypes of persistent median artery, almar and forearm have been described. They supply the forearm and the hand, or the forearm only, respectively," the researchers explain. "This pattern of median artery arrangement has been referred to as the antebrachial phenotype."

For now, the study was of just Australians of European descent, and the scientists say in the paper that they don't yet understand the scope of how this feature has evolved around the world. They used volunteer-donated remains and only checked for the presence of *a* median artery, not a particularly palmar or forearm median artery.

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This study is just one small step toward a much larger study of this feature in different population groups, born in different time periods and all around the world.

popularmechanics.com, 12 October 2020

<https://www.popularmechanics.com>

This rare bird is male on one side and female on the other

2020-10-06

In Rector, Pa., researchers have spotted one strange bird.

This rose-breasted grosbeak has a pink breast spot and a pink “wing pit” and black feathers on its right wing — telltale shades of males. But on its left side, the songbird displays yellow and brown plumage, hues typical of females.

Annie Lindsay had been out capturing and banding birds with identification tags with her colleagues at Powdermill Nature Reserve in Rector on September 24 when a teammate hailed her on her walkie-talkie to alert her of the bird’s discovery. Lindsay, who is banding program manager at Powdermill, immediately knew what she was looking at: a half-male, half-female creature known as a gynandromorph.

“It was spectacular. This bird is in its nonbreeding [plumage], so in the spring when it’s in its breeding plumage, it’s going to be even more starkly male, female,” Lindsay says. The bird’s colors will become even more vibrant, and “the line between the male and female side will be even more obvious.”

Bottom of Form

Such birds are rare. Lindsay has seen only one other similar, but less striking, bird 15 years ago, she says.

Gynandromorphs are found in many species of birds, insects and crustaceans such as crabs and lobsters. This bird is likely the result of an unusual event when two sperm fertilize an egg that has two nuclei instead of one. The egg can then develop male sex chromosomes on one side and female sex chromosomes on the other, ultimately leading to a bird with a testis and other male characteristics on one half of its body and an ovary and other female qualities on the other half.

Gynandromorphs are found in many species of birds, insects and crustaceans such as crabs and lobsters.

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Unlike hermaphrodites, which also have genitals of both sexes, gynandromorphs are completely male on one side of the body and female on the other.

Scientists don’t know if these birds behave more like males or females, or if they can reproduce. UCLA biologist Arthur Arnold studied one gynandromorph zebra finch that used a male song and behavior to attract females. But there need to be more studies on whether behavior related to one sex is more dominant than the other across gynandromorphs, he says. Such research is tough, however, because the creatures are so rare.

In 64 years of bird banding, Powdermill’s Avian Research Center has recorded fewer than 10 such birds. After marveling over their new find in the field, Lindsay and her colleagues took the rose-breasted grosbeak (*Pheucticus ludovicianus*) to the laboratory, measured its wing span and plucked out four feathers to obtain its DNA for future studies. The team later took photographs and TikTok videos with the tiny feathery guest before letting it fly on its way.

sciencenews.org, 6 October 2020

<https://www.sciencenews.org>

Why we’re entering the golden age of email

2020-10-15

We all know that email is where your work happens. But given your inbox’s role as the central hub of your professional life, email has largely failed to become a more effective communication tool—until recently.

Part of the reason why email has stagnated is that its one of the oldest digital technologies still being used daily. The first “email” was sent on October 29, 1969, and we’re still sending them in 2020. Some of the underlying technologies have certainly evolved since that first email, but most of the protocols being used are from the previous century. SMTP (sending email) was created in 1982. IMAP (downloading email) was created in 1986. If you think about all that’s changed with technology since the 1980s, it’s baffling to think that we’re still so reliant on protocols that are so old.

Because email is built on open standards, it has remained decentralized. Unlike many other types of tech these days, that means that no single company can own and control it. Anyone can start a company that provides an email service, and they will be compatible with all of the other

The first “email” was sent on October 29, 1969, and we’re still sending them in 2020.

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email platforms on the market. If email were built on a closed system, it would likely be controlled by a handful of big technology companies—just like some of the newer modes of communication.

But there's a downside to email's open nature. For the past two decades, email hasn't gotten much attention or financial investment. During the early 2000s, the most significant innovation was Google offering one gigabyte of storage. Since then, what was the last considerable innovation we've seen in email? If you can't think of anything, it's because there hasn't been much. It's because even though anyone can start an email service, Big Tech—primarily Google, Microsoft, and Apple—still controls the vast majority of active email accounts.

Since every device included a “good enough” email account and email accounts were given away like candy at Halloween, there wasn't much of a market for anyone to come along with any exciting (and paid) solution. Apps like Mailbox and Sparrow offered some new UI tricks, but they had no viable business models and couldn't convince many people to pay for an app subscription. There was little incentive for anyone to innovate.

In addition, email's open nature has turned into a paradox, where it's nearly impossible to modernize it without virtually every email provider agreeing on the change. This stalemate led to the development of a host of new services designed to streamline communications. Companies needed new solutions, so they built their own. During the rise of the app economy, services like WhatsApp were designed to eliminate SMS fees for sending short messages. Slack and Microsoft Teams were created to help solve endless email threads. While all of these new services are fun and exciting, they're all built on closed platforms.

There's certainly a place for messaging, but email is still the centralized communication portfolio for many things that happen in our work and personal lives. When you want to reach out to a new client, you'll use email. When you need to file your month-end expenses, you'll find those receipts in your email. Email is still the focal point for containing our digital memories and footprint; and for most of our outbound, cross-organization communications.

However, in 2020, we've all been thrown into a tailspin, thanks to a global pandemic. We've become ever more reliant on technology to keep our organizations and our work moving forward. As much as people have tried to get away from email, they've realized it's still the most efficient way to communicate. People have realized that they still need and use email daily even with new tools like Microsoft Teams and Slack, especially as entire

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companies have transitioned to remote work. And if they're still going to need email, then all of these chat-based tools are just another inbox to check and manage. It's created a message overload. We end up with more platforms or apps to manage, more distractions, and more time wasted chasing down bits of info and tasks spread across a multitude of services.

That's why email must evolve into something more up-to-date and more streamlined. The constant stress of jumping between chat apps, project management apps, shared docs, and even your calendar is taking its toll. What we need is a solution that enhances the way we communicate and collaborate rather than hinders it, a solution that reimagines what email would look like if it was built today.

It's clear that we need to redesign email from the ground up and simplify the way people communicate with each other now—not in 1969. We need to rethink our communications from a 21st century perspective. We need solutions that are as powerful as they are simple—but the bottom line is, we need email.

That's probably why we've started to see a lot of news about email. Countless new products associated with email launched in 2020. Hey, from the creators of Basecamp, launched in June to much excitement. OnMail, a new email service from the creators of the Edison email app, was announced in April and launched a few weeks ago. Readdle, the creators of Spark, have continued to pour energy and investment into their app. With such investments in new email apps and services, it's clear that email is becoming the darling of Silicon Valley again. There has been more innovation in email in the past two years than in the past 10.

When our world turned upside in 2020, we retreated to the tools we know and trust. Everyone is realizing what I've known for a long time—email is finally sexy again.

[fastcompany.com](https://www.fastcompany.com), 15 October 2020

<https://www.fastcompany.com>

How many organs are in the human body?

2020-10-12

Since ancient times, humankind has sought to understand the guts inside us. Ancient Egyptians handled human organs as they removed them for embalming. Medical manuscripts found in an ancient Chinese tomb may be the earliest-known anatomical writing about the human body.

Thousands of years later, do we know how many organs are in the human body?

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Thousands of years later, do we know how many organs are in the human body?

Organs are collections of tissues that work together for a common goal, explained Lisa M.J. Lee, an associate professor in the Department of Cell & Developmental Biology at the University of Colorado School of Medicine. "Every organ provides a function for human performance or survival," she told Live Science.

But not every organ is necessary for survival. Only five organs — the brain, heart, liver, at least one kidney, and at least one lung are absolutely essential for living. Losing total function of any one of these vital organs spells death. Remarkably, the human body can survive without a lot of other organs, or by replacing a non-functioning organ with a medical device.

As for counting organs in the human body, it depends on whom you ask and how you count, Lee said. Although no one knows where the number originates, the general count is 78 organs, she said. This list includes the vital organs: the tongue, stomach, thyroid, urethra, pancreas, plus many other single or pairs of organs. Bones and teeth are each counted only once.

Among anatomists, viewpoints differ on what counts as an organ. A histologist like Lee, who studies tissue at the microscopic level, may have a longer list of organs than a gross anatomist, who studies what's visible to the unaided eye. For example, scientists made headlines in 2017 for labeling the mesentery, which attaches the intestines to the abdominal wall, as an organ. Even though the scientists provided new evidence to call it an organ, it was not controversial, as many histologists and anatomists agreed, Lee explained. But there's no group charged with keeping an official count of the organs or deciding what qualifies as an organ.

Thinking microscopically, when multiple types of tissues join together and function together, the unit is an organ, she said. Lee could call a nail, or structures that support the nail, an organ, and count each tooth as an individual organ. "I would consider each bone an organ, and all 206 bones collectively together, is considered an organ system." Because bones are already listed once on the list of 78, to get a tally of the total number of organs using this definition, just add 205, for a total of 284 organs.

Counting each tooth separately brings the list to 315 organs. Many other organs are listed only once, even though there are many of them throughout the body. For instance, ligaments and tendons

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could dramatically increase the total number of organs when counted individually. This game is endless. The list of 78 counts the nerves just once, but there are trillions of them.

Exhausted? Lee often tells her medical and graduate school students to be OK with this type of ambiguity. However you count them, you should take care of the organs you do have, she added. "More and more, I'm finding out how important it is that you put the right stuff in your body to feed your cells, your tissues and your organs," Lee said. After all, the body only has so many performers at its organ recital.

[livescience.com](https://www.livescience.com), 12 October 2020

<https://www.livescience.com>

Pufferfish may be carving mysterious 'crop circles' near Australia

2020-10-13

Japan's white-spotted pufferfish are renowned for producing complex, ringed patterns in the sand. Now, 5,500 kilometers away in Australia, scientists have discovered what appear to be dozens more of these creations.

While conducting a marine life survey out on Australia's North West Shelf near subsea gas infrastructure with an autonomous underwater vehicle, marine ecologist Todd Bond spotted a striking pattern on the seafloor, more than 100 meters deep. "Immediately, I knew what it was," recounts Bond, of the University of Western Australia in Perth. Bond and his colleagues continued the survey, ultimately finding nearly two dozen more.

Until now, these undersea "crop circles" were found only off the coast of Japan. First spotted in the 1990s, it took two decades to solve the mystery of what created them. In 2011, scientists found the sculptors — the diminutive males of what was then a new species of *Torquigener* pufferfish. The patterns are nests, meticulously plowed over the course of days and decorated with shells to entice females to lay their eggs in the center.

A hovering autonomous underwater vehicle (HAUV) deployed along subsea natural gas infrastructure off Australia's coast in September 2018 captured footage of something surprising: a rippled ring carved into the sand. Researchers eventually discovered nearly two dozen of these circles, similar to the elaborate nests crafted by white-spotted pufferfish

Until now, these undersea "crop circles" were found only off the coast of Japan.

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males near Japan, making it the first such find outside Japan. While it's not known what species created the Australian rings, an unidentified pufferfish was seen fleeing the site of one of them.

While there's no video confirmation that pufferfish are building the nests in Australia, the structures are nearly identical to those in Japan, even sharing a similar number of ridges, Bond and his colleagues report in the November 2020 *Journal of Fish Biology*. And when a colleague deployed an underwater video system in the area, the contraption luckily landed almost directly atop a circle and captured footage of a small pufferfish fleeing the formation.

The Australian circles lie in much deeper waters than Japan's — 130 meters or more deep compared with about 30 meters deep in Japan. Australian pufferfish known in the area typically inhabit more shallow waters, raising questions about the identity of the species responsible.

Bond says the images captured of the likely piscine culprit are too poor to make a definitive identification. The circles could have been made by the same species that builds Japan's nests, the white-spotted pufferfish (*Torquigener albomaculosus*), or the culprit could be a different, local species — possibly one totally new to science.

Bottom of Form

"It is surprising to find the circles ... at a depth where there is not much light," says Elisabet Forsgren, a behavioral ecologist at the Norwegian Institute for Nature Research in Trondheim. If the nests are meant to be a visual signal to attract females, they may be hard to see in such a dim spot.

Bond says that the discovery raises more questions that may ultimately help us understand the evolution of pufferfishes, a group already awash in eccentricities. Not only are they among the most toxic vertebrates on Earth, but they've completely lost their ribs and pelvic bones to make room when they "puff" with water (*SN: 8/1/19*). Among the questions: If the Australian circles are made by a different species from Japan's, did the two fishes' artistic skills evolve separately?

"It's kind of humbling to know that there's so much out there that we don't know," says Bond. "It's also a little bit scary as well. This is a reflection of,

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obviously, a key part to the reproduction of maybe a new species, but we just know nothing about it. We didn't even know these existed."

sciencenews.org, 13 October 2020

<https://www.sciencenews.org>

What's the first species humans drove to extinction?

2020-10-11

Sometime in the late 1600s, in the lush forests of Mauritius, the very last dodo took its last breath. After centuries of untroubled ferreting in the tropical undergrowth, this species met its untimely end at the hands of humans, who had arrived on the island less than 100 years before. With their penchant for hunting, habitat destruction and the release of invasive species, humans undid millions of years of evolution, and swiftly removed this bird from the face of the Earth.

Since then, the dodo has nestled itself in our conscience as the first prominent example of human-driven extinction. We've also used the dodo to assuage our own guilt: the creature was fat, lazy and unintelligent — and as popular story goes, those traits sealed its inevitable fate.

But in fact, we couldn't be more wrong, said Julian Hume, a paleontologist and research associate with the National History Museum in the United Kingdom. He studies the fossils of extinct species, and has devoted a portion of his career to correcting the dodo's dismal reputation. By digitally modelling the remains of a dodo's skeleton, he's produced a 3D digital reconstruction that draws an altogether different picture of a bird that was faster, more athletic and far brainier than popular culture has led us to believe. «It was nothing like this big, fat, bulgy thing that was just waddling around. This bird was super adapted to the environment of Mauritius," Hume told Live Science. Instead, humans' unrelenting exploitation was the real culprit behind the dodo's untimely death.

PLAY SOUND

But that's not all we've gotten wrong. Despite the commonly held belief, the dodo actually wasn't the first creature that humans drove to extinction — not by a long shot. In fact, humanity was wiping out the world's fauna thousands of years before we set eyes on the dodo. "There was certainly a lot more going on before and after that event," said Hume.

So, if the iconic dodo wasn't the first species we drove to the brink, then which animal gets this disheartening title, instead?

Instead, humans' unrelenting exploitation was the real culprit behind the dodo's untimely death.

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Humans on the move

We've grown accustomed to thinking about human-driven species extinction as a relatively recent trend in our history. Yet, researchers have found convincing palaeontological evidence that dismantles that idea.

"The real problem started when we, as humans, started migrating," Hume said. That starting point is still debated, but most recent estimates suggest that migrations that led to lasting populations of humans spread across the globe began with the movement of hominids — Neanderthals and other ancient human relatives, as well *Homo sapiens* — out of Africa and southeast Asia, roughly 125,000 years ago. This is where the evidence gets interesting. As humans left their ancestral homes, and over the following tens of thousands of years went on to colonize Eurasia, Oceania, North and South America, the fossil record shows a parallel uptick in the extinction in large-bodied animals — also known as megafauna — across those continents.

"As [hominids] migrated out of Africa, you see this incredibly regular pattern of extinction," said Felisa Smith, a professor of ecology and evolutionary biology at the University of New Mexico, who studies how animals' body sizes have changed over the course of history. As she and her colleagues explained in a 2018 study published in the journal Science, each time our ancestors set foot in new places, fossil records show that large-bodied species — the humongous prehistoric relatives of elephants, bears, antelope and other creatures — started going extinct within a few hundred to 1,000 years, at most. Such rapid extinction timescales don't occur at any other point in the last several million years (not since the non-avian dinosaurs were wiped out by an asteroid about 65 million years ago.) «The only time you see it is when humans are involved, which is really striking,» Smith said.

Some of those early lost species would seem like fantastical beasts if they roamed Earth today. For example, "There was an armadillo-like thing called the glyptodon, which was the size of a Volkswagen bus," Smith told Live Science. Glyptodons, many equipped with vicious-looking spiked tails, disappeared from the Americas at the end of the last ice age, roughly 12,000 years ago — which is probably connected to the earlier arrival of humans there. The number of gigantic Eurasian cave bears, several hundred pounds heavier than grizzly bears today, went into a steep decline about 40,000 years ago, around the same time that humans began to spread across their habitat. South America was once home to

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lumbering giant ground sloths — and humans were also the most likely candidate in their demise, about 11,000 years ago.

What made large animals, in particular, so susceptible to humanity's spread? Megafauna likely represented food, or a threat, to incoming humans. What's more, animals that had never encountered humans before were probably unwary of these strange newcomers migrating into their unspoiled lands, which might have increased their vulnerability to attack. Unlike other smaller animals that breed more rapidly, megafauna also reproduce more slowly and so have smaller populations compared with other species, Hume explained: "So if you take out a big section of [a population] they cannot reproduce quickly enough to build up numbers again."

It wasn't just hunting that posed a threat — but also the spread of human-caused fires that would have destroyed swathes of habitat, and increasing competition from humans for food. For instance, it's thought that by preying heavily on the same herbivores, growing numbers of hungry humans helped drive the extinction of the short-faced bear, a gigantic South American species that once stood at over 10 feet (3 meters) tall, and died out roughly 11,000 years ago. Climate change, paired with human impacts like hunting, also proved to be a lethal combination for some megafauna — most famously, mammoths, which went extinct about 10,500 years ago (except for the dwarf woolly mammoth, which survived until about 4,000 years ago on an island off northern Russia). "If you combine climate change with a negative human impact, it's a disaster," said Hume.

An answer?

All of this is to say that humans have systematically wiped out the species around us from almost the beginning of our history. Our migration prompted "a disaster across the world," said Hume. "We weren't very pleasant." Unfortunately, we've continued our ancestors' legacy, with, among thousands of other species, the eradication of Madagascan hippos 1,000 years ago, the loss of moa birds in New Zealand 600 years ago, and the decimation of passenger pigeons 106 years ago. We are also responsible for ongoing extinctions today.

But this still hasn't answered the question of what species went extinct *first*. And here's the catch: the data on human-driven extinction across the planet is only reliable as far back as about 125,000 years — but that doesn't mean we weren't driving animals to extinction before that in Africa, too. In fact, there's compelling evidence to suggest that before

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humans migrated out, they unleashed their hunting instincts on species there as well.

Smith's research has revealed that the average body size of African animals 125,000 years ago was only half that of species that were present on other continents around the world. "Africa is one of the largest continents, so it should have had a mean body size similar to that of the Americas and Eurasia where it was roughly about 100 kilograms [220 lbs.]," Smith said. "The fact that it didn't suggests that there had already been an effect of hominids on megafauna in Africa, prior to 125,000 years ago."

In essence, because the rest of history tells us that humans are good at dispatching the largest creatures in an ecosystem, we can make a fairly safe assumption that hominids in Africa at the time could have been responsible for extinctions going even further back in time.

Still, there's no way to know for sure what that 'first' species would have been — though Smith takes a wild guess: "It was probably some species in the elephant family. But whether that's palaeomastodon, or stegodon" — the latter being a behemoth with tusks that measured 10 feet (3 meters) long - "I couldn't tell you."

Clues for the future

We may not have a clear answer to that original question - but perhaps the more important one to ask is what humanity's legacy of extinction can teach us about conservation, going into the future.

Past extinctions have revealed that when animals — especially megafauna — disappear, there are profound ecological consequences. Whole landscapes are transformed in the absence of their shaping effects, with changes to vegetation and species diversity. Smith has even [published research](#) showing that the decline of global megafauna in past millennia led to dips in the amount of methane they burped out — with potentially transformative consequences for global climate. What's more, when animals disappear, whole rafts of dependent species go down with them. The iconic dodo presents one such cautionary tale: when the birds died out, so did a [Mauritian dung beetle](#) that relied on dodo feces to survive.

Understanding human-driven extinctions of the past can help us figure out what the environmental consequences have been, explained Smith, and how we can limit those in the future by protecting the species that remain. Even the dodo's extinction provides clues that are helping us

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preserve ecosystems today. Hume is working on a project to catalog pollen spores present in the sediments around dodo [fossils](#), to build up a detailed picture of the lush, palm-fringed forests they once roamed. That's helping conservationists to rewind the island with vegetation that was once there. "We're actually reconstructing the exact species of plants and trees from the environment the dodo was living in, before humans arrived," Hume said.

A bit of paradise was lost when we drove the dodo to extinction — not to mention the thousands of species whose demise came before that. But perhaps with hindsight, and the willingness to learn from our mistakes, some of that can be reclaimed.

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 11 October 2020

<https://www.livescience.com>

Do we live in a simulation? Chances are about 50-50 2020-10-15

It is not often that a comedian gives an astrophysicist goose bumps when discussing the laws of physics. But comic Chuck Nice managed to do just that in a recent episode of the podcast *StarTalk*. The show's host Neil deGrasse Tyson had just explained the simulation argument—the idea that we could be virtual beings living in a computer simulation. If so, the simulation would most likely create perceptions of reality on demand rather than simulate all of reality all the time—much like a video game optimized to render only the parts of a scene visible to a player. "Maybe that's why we can't travel faster than the speed of light, because if we could, we'd be able to get to another galaxy," said Nice, the show's co-host, prompting Tyson to gleefully interrupt. "Before they can program it," the astrophysicist said, delighting at the thought. "[So the programmer put in that limit.](#)"

Such conversations may seem flippant. But ever since Nick Bostrom of the University of Oxford wrote a [seminal paper about the simulation argument in 2003](#), philosophers, physicists, technologists and, yes, comedians have been grappling with the idea of our reality being a simulacrum. Some have tried to identify ways in which we can discern if we are simulated beings. Others have attempted to calculate the chance of us being virtual entities. Now a new analysis shows that the odds that we are living in base reality—meaning an existence that is not simulated—are pretty

Some have tried to identify ways in which we can discern if we are simulated beings.

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much even. But the study also demonstrates that if humans were to ever develop the ability to simulate conscious beings, the chances would overwhelmingly tilt in favor of us, too, being virtual denizens inside someone else's computer. (A caveat to that conclusion is that there is little agreement about what the term "consciousness" means, let alone how one might go about simulating it.)

In 2003 Bostrom imagined a technologically adept civilization that possesses immense computing power and needs a fraction of that power to simulate new realities with conscious beings in them. Given this scenario, his simulation argument showed that at least one proposition in the following trilemma must be true: First, humans almost always go extinct before reaching the simulation-savvy stage. Second, even if humans make it to that stage, they are unlikely to be interested in simulating their own ancestral past. And third, the probability that we are living in a simulation is close to one. **PLAY SOUND**

Before Bostrom, the movie *The Matrix* had already done its part to popularize the notion of simulated realities. And the idea has deep roots in Western and Eastern philosophical traditions, from Plato's cave allegory to Zhuang Zhou's butterfly dream. More recently, Elon Musk gave further fuel to the concept that our reality is a simulation: "The odds that we are in base reality is one in billions," he said at a 2016 conference.

"Musk is right if you assume [propositions] one and two of the trilemma are false," says astronomer David Kipping of Columbia University. "How can you assume that?"

To get a better handle on Bostrom's simulation argument, Kipping decided to resort to Bayesian reasoning. This type of analysis uses Bayes's theorem, named after Thomas Bayes, an 18th-century English statistician and minister. Bayesian analysis allows one to calculate the odds of something happening (called the "posterior" probability) by first making assumptions about the thing being analyzed (assigning it a "prior" probability).

Kipping began by turning the trilemma into a dilemma. He collapsed propositions one and two into a single statement, because in both cases, the final outcome is that there are no simulations. Thus, the dilemma pits a physical hypothesis (there are no simulations) against the simulation hypothesis (there is a base reality—and there are simulations, too). "You just assign a prior probability to each of these models," Kipping says. "We just assume the principle of indifference, which is the default assumption when you don't have any data or leanings either way."

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So each hypothesis gets a prior probability of one half, much as if one were to flip a coin to decide a wager.

The next stage of the analysis required thinking about "parous" realities—those that can generate other realities—and "nulliparous" realities—those that cannot simulate offspring realities. If the physical hypothesis was true, then the probability that we were living in a nulliparous universe would be easy to calculate: it would be 100 percent. Kipping then showed that even in the simulation hypothesis, most of the simulated realities would be nulliparous. That is because as simulations spawn more simulations, the computing resources available to each subsequent generation dwindle to the point where the vast majority of realities will be those that do not have the computing power necessary to simulate offspring realities that are capable of hosting conscious beings.

Plug all these into a Bayesian formula, and out comes the answer: the posterior probability that we are living in base reality is almost the same as the posterior probability that we are a simulation—with the odds tilting in favor of base reality by just a smidgen.

These probabilities would change dramatically if humans created a simulation with conscious beings inside it, because such an event would change the chances that we previously assigned to the physical hypothesis. "You can just exclude that [hypothesis] right off the bat. Then you are only left with the simulation hypothesis," Kipping says. "The day we invent that technology, it flips the odds from a little bit better than 50–50 that we are real to almost certainly we are not real, according to these calculations. It'd be a very strange celebration of our genius that day."

The upshot of Kipping's analysis is that, given current evidence, Musk is wrong about the one-in-billions odds that he ascribes to us living in base reality. Bostrom agrees with the result—with some caveats. "This does not conflict with the simulation argument, which only asserts something about the disjunction," the idea that one of the three propositions of the trilemma is true, he says.

But Bostrom takes issue with Kipping's choice to assign equal prior probabilities to the physical and simulation hypothesis at the start of the analysis. "The invocation of the principle of indifference here is rather shaky," he says. "One could equally well invoke it over my original three alternatives, which would then give them one-third chance each. Or one could carve up the possibility space in some other manner and get any result one wishes."

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Such quibbles are valid because there is no evidence to back one claim over the others. That situation would change if we can find evidence of a simulation. So could you detect a glitch in the Matrix?

Houman Owhadi, an expert on computational mathematics at the California Institute of Technology, has thought about the question. "If the simulation has infinite computing power, there is no way you're going to see that you're living in a virtual reality, because it could compute whatever you want to the degree of realism you want," he says. "If this thing can be detected, you have to start from the principle that [it has] limited computational resources." Think again of video games, many of which rely on clever programming to minimize the computation required to construct a virtual world.

For Owhadi, the most promising way to look for potential paradoxes created by such computing shortcuts is through quantum physics experiments. Quantum systems can exist in a superposition of states, and this superposition is described by a mathematical abstraction called the wave function. In standard quantum mechanics, the act of observation causes this wave function to randomly collapse to one of many possible states. Physicists are divided over whether the process of collapse is something real or just reflects a change in our knowledge about the system. "If it is just a pure simulation, there is no collapse," Owhadi says. "Everything is decided when you look at it. The rest is just simulation, like when you're playing these video games." **PLAY SOUND**

To this end, Owhadi and his colleagues have worked on five conceptual variations of the double-slit experiment, each designed to trip up a simulation. But he acknowledges that it is impossible to know, at this stage, if such experiments could work. "Those five experiments are just conjectures," Owhadi says.

Zohreh Davoudi, a physicist at the University of Maryland, College Park, has also entertained the idea that a simulation with finite computing resources could reveal itself. Her work focuses on strong interactions, or the strong nuclear force—one of nature's four fundamental forces. The equations describing strong interactions, which hold together quarks to form protons and neutrons, are so complex that they cannot be solved analytically. To understand strong interactions, physicists are forced to do numerical simulations. And unlike any putative supercivilizations possessing limitless computing power, they must rely on shortcuts to make those simulations computationally viable—usually by considering spacetime to be discrete rather than continuous. The most advanced

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result researchers have managed to coax from this approach so far is the simulation of a single nucleus of helium that is composed of two protons and two neutrons.

"Naturally, you start to ask, if you simulated an atomic nucleus today, maybe in 10 years, we could do a larger nucleus; maybe in 20 or 30 years, we could do a molecule," Davoudi says. "In 50 years, who knows, maybe you can do something the size of a few inches of matter. Maybe in 100 years or so, we can do the [human] brain."

Davoudi thinks that classical computers will soon hit a wall, however. "In the next maybe 10 to 20 years, we will actually see the limits of our classical simulations of the physical systems," she says. Thus, she is turning her sights to quantum computation, which relies on superpositions and other quantum effects to make tractable certain computational problems that would be impossible through classical approaches. "If quantum computing actually materializes, in the sense that it's a large scale, reliable computing option for us, then we're going to enter a completely different era of simulation," Davoudi says. "I am starting to think about how to perform my simulations of strong interaction physics and atomic nuclei if I had a quantum computer that was viable."

All of these factors have led Davoudi to speculate about the simulation hypothesis. If our reality is a simulation, then the simulator is likely also discretizing spacetime to save on computing resources (assuming, of course, that it is using the same mechanisms as our physicists for that simulation). Signatures of such discrete spacetime could potentially be seen in the directions high-energy cosmic rays arrive from: they would have a preferred direction in the sky because of the breaking of so-called rotational symmetry.

Telescopes "haven't observed any deviation from that rotational invariance yet," Davoudi says. And even if such an effect were to be seen, it would not constitute unequivocal evidence that we live in a simulation. Base reality itself could have similar properties.

Kipping, despite his own study, worries that further work on the simulation hypothesis is on thin ice. "It's arguably not testable as to whether we live in a simulation or not," he says. "If it's not falsifiable, then how can you claim it's really science?"

For him, there is a more obvious answer: Occam's razor, which says that in the absence of other evidence, the simplest explanation is more likely to be correct. The simulation hypothesis is elaborate, presuming realities

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nested upon realities, as well as simulated entities that can never tell that they are inside a simulation. "Because it is such an overly complicated, elaborate model in the first place, by Occam's razor, it really should be disfavored, compared to the simple natural explanation," Kipping says.

Maybe we are living in base reality after all — *The Matrix*, Musk and weird quantum physics notwithstanding.

livescience.com, 15 October 2020

<https://www.livescience.com>

Adorable ancient sea cows once swam through now-bone dry Egyptian desert

2020-10-15

About 40 million years ago, a gentle marine giant glided through the water in what is now a bone-dry desert in Egypt, according to new research.

The study suggests that during the late Eocene, about 40 million to 35 million years ago, Egypt's Eastern Desert was home to the ancient relatives of manatees (also endearingly called sea cows) and dugongs.

This isn't the first fossil of an ancient Sirenia — the order that includes manatees, dugongs and their extinct relatives, like the Stellers sea cow — discovered in Egypt, but it is the only known fossil Sirenia in these particular rock units dating back to the Eocene, known as the Beni Suef Formation.

PLAY SOUND

The research, which has yet to be published in a peer-reviewed journal, was presented online yesterday (Oct. 13) at the Society of Vertebrate Paleontology's annual conference, which is virtual this year due to the COVID-19 pandemic.

Scientists found the Sirenia fossils, including some of the creature's vertebrae, ribs and limb bones, in 2019. "It is almost a grown individual," said Mohamed Korany Ismail Abdel-Gawad, a lecturer of vertebrate paleontology and supervisor of the Vertebrate Paleontology Laboratory at Cairo University.

As with whales, the mammal ancestors of the Sirenia order used to live on land before they moved into the sea. The earliest known Sirenia, a species

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known as *Pezosiren portelli*, dates to the middle Eocene of Jamaica, about 50 million years ago. This animal was semiaquatic, and it still had front and hind limbs, like a land creature, according to a 2012 publication on Sirenia published by the University of Michigan, detailing ancient Sirenia found in the Western Desert of Egypt.

Over time, this order of herbivorous marine mammals became completely aquatic. By the late Eocene, when this newfound Sirenia lived, all known Sirenia species had flippers for front limbs and had lost their hind limbs, according to the 2012 publication.

Today's sea cows eat seagrasses, which grow in relatively clear, shallow waters where the plants can harvest food from light using photosynthesis. "This was seemingly true for most sirenians throughout their evolutionary history, and Sirenians are thus important paleoenvironmental indicators," according to the 2012 publication.

The newfound Sirenia fossils support other evidence suggesting that the Eastern Desert was a shallow marine environment at that time. "As they are herbivorous mammals, they are inhabiting the coastal marine waters and marine wetlands," Abdel-Gawad told Live Science.

Sirenia fossils dating to the Eocene (56 million to 34 million years ago) and Oligocene (34 million to 23 million years ago) epochs are well known in Egypt, especially in the Fayum area, in the Western Desert, southwest of Cairo, he added. In fact, the newfound specimen is from the same time as specimens from the Dugongidae family found in Fayum, Abdel-Gawad said.

The newly discovered Sirenia is also from the Dugongidae family (which includes dugongs but not manatees), he said.

Sirenia fossils dating to the Eocene are also found in other regions of Africa that are now dry land, including Libya, Somalia, Togo and Madagascar, Abdel-Gawad and his colleagues wrote in their abstract. Sirenia exists in Egypt today; there is a small population of Red Sea dugong, according to the book "Oceanographic and Biological Aspects of the Red Sea" (Springer Oceanography, 2018).

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As with whales, the mammal ancestors of the Sirenia order used to live on land before they moved into the sea.

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In the cannabis patch, a patchwork of safety standards—and in some cases none at all

2020-10-14

Although 35 states, three U.S. territories, and the District of Columbia have legalized cannabis for recreational or medical use, there still are no uniform standards for regulating potentially harmful contaminants in cannabis products. And with five more states voting this November on whether to allow cannabis for the first time, the problem will only grow.

That's largely because the drug remains illegal at the federal level. In the absence of oversight by the U.S. Food and Drug Administration (FDA) or any other arm of the federal government, regulators in each state have had to decide on their own how to manage common contaminants including pesticides, molds, metals and solvents. This has resulted in a patchwork of policies affording widely varying levels of consumer protection — and in some cases, none at all.

"Each state successively has put together their own regulations," said Josh Wurzer, president of California-based cannabis testing company SC Labs. "No two states are alike in their quality requirements." A report published in April by the United States Pharmacopoeia (USP), a widely respected non-governmental organization whose safety standards for medicines, food ingredients and dietary supplements are often adopted by the FDA, was supposed to help.

But six months later, its proposed guidelines for monitoring pesticides, metals and biological contaminants specifically on cannabis flower — the cured "buds" sold in dispensaries for smoking, vaporizing or processing into other products — seem to have gained little traction in the industry or among state regulators.

Contaminants can find their way onto cannabis at many stages, from cultivation to packaging. Unlike with fruits and vegetables, any pesticides applied directly or blown from neighboring farms can't be washed off. Cannabis plants are also known to accumulate trace metals like lead and arsenic from soil, water and fertilizers. In damp environments they can also harbor toxic mold and bacteria.

Smoking or vaporizing contaminated flower can ferry these unwelcome passengers straight to the bloodstream via the lungs, which health scientists consider a far more sensitive route of exposure than ingestion. In individuals with compromised immune systems, some microbes that grow on cannabis can cause acute distress or even death, such as in the case of a

"No two states are alike in their quality requirements."

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California cancer patient whose death of a rare fungal infection in 2017 — before the state began requiring testing — was traced back to tainted medical marijuana.

Perhaps more likely is the possibility that long-term exposure to pesticides, metals and other contaminants, especially through inhalation, could contribute to chronic disease or other health effects that may take decades to appear.

Metals and pesticides on flower can also become concentrated in extracts used for vaporization or in cannabis edibles, drinks and tinctures. These types of products can additionally contain residues of solvents used in some extraction processes.

USP spokesperson Anne Bell said that regulators from only two states — Colorado and Maryland — have been in touch with USP regarding the new report since its publication in the Journal of Natural Products.

A representative of the Colorado Department of Public Health and Environment confirmed that experts with a state marijuana policy working group had sought clarification from USP on its recommendations around mold and other microbiological contaminants, but had not proposed any changes to state policy.

An official with the Maryland Medical Cannabis Commission, meanwhile, said that state regulators did not use the document during a recent revision of testing methods and limits for cannabis contaminants.

"This didn't get a lot of play, as much as I would have hoped," said Ethan Russo, one of 16 co-authors of the report and former president of the International Cannabinoid Research Society. "I did hope that people would be pointing to this saying, 'Look, now there are some standards on how you do things.' It should be possible for the industry to have some targets and take them to heart. My feeling is unless the industry does it, it's going to be done very poorly by politicians."

Russo noted that his home state of Washington, which along with Colorado kicked off the current wave of adult-use legalization in 2012, still doesn't require pesticide testing for recreational cannabis.

Wurzer, who also contributed to the report, said he believes its release during the coronavirus pandemic may be a factor in its quiet reception so far — but that regulators in states revising or writing new testing guidelines in the future will turn to it as needed.

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"I think this is the first step toward a unified quality-control document that we can look at nationally, and I think it did slip under the nose of the industry," Wurzer said. "I think regulators will find their way to this document, and certainly I believe that this will be the basis for regulations going forward."

Other efforts are underway to assist state regulators in developing consistent, science-based rules for contaminant testing in cannabis products including foods, drinks and concentrates, said Holly Johnson, chief science officer of the trade group American Herbal Products Association and another of the report's co-authors.

Organizations including the [Association of Analytical Chemists](#), the [American Society for Testing and Materials](#) and the [American Chemical Society](#) have all established committees in recent years tasked with developing methods and standards for cannabis testing.

The goal of this work, said Johnson, is to lay a foundation for eventual federal regulation. "We hope to have these limits and validated methods in place so that when the FDA incorporates cannabis into the federal system, these quality monographs are there," she said.

Industry insiders don't expect that to happen until cannabis is reclassified under the federal Controlled Substances Act. While they wait, the existing system is likely to continue to be marred by inconsistencies that afford consumers in different states drastically different levels of protection.

"I'm just amazed that the industry can have so much dysfunction and so many variables in how they're being regulated," said Robert Thomas, an analytical chemist based in Maryland and author of a book on measuring heavy metals in cannabis. "There's no consensus whatsoever."

Among metals, for example, New York's medical-only program requires testing for arsenic, cadmium, lead, mercury, chromium, antimony, nickel and zinc. Colorado tests for just the first four on New York's list, and generally allows higher levels. Oregon, meanwhile, whose recreational cannabis program has some of the nation's strictest pesticide limits, doesn't test for metals at all.

In its new report, the USP codifies previous recommendations to test for and limit arsenic, cadmium, lead and mercury in cannabis flower. Its guidelines are currently followed by California and Massachusetts for recreational products, and by Rhode Island and Arkansas for medical

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uses, from among nearly three dozen states with some level of cannabis legalization.

Next month, Arizona, Mississippi, Montana, New Jersey and South Dakota will have a chance to join the fray. In states where ballot measures pass, regulators will have to piece together their own policies for testing and product safety.

If history is any guide, no two sets of rules will be the same. And for consumers and patients who assume their legal weed is safe, where they live will continue to determine what that means.

"It's really crying out for federal oversight here," Thomas said. "It's a mess. Clearly there has to be some oversight at some point."

[fairwarning.org](https://www.fairwarning.org), 14 October 2020

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Technical Notes

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

CHEMICAL EFFECTS

[Heme oxygenase-1 \(HO-1\) assists inorganic arsenic-induced immune tolerance in murine dendritic cells](#)

[Endocrine-disruptive chemicals as contaminants of emerging concern in wastewater and surface water: A review](#)

[Towards setting public health guidelines for chemicals in indoor settled dust?](#)

ENVIRONMENTAL RESEARCH

[Influence of lockdown caused by the COVID-19 pandemic on air pollution and carcinogenic content of particulate matter observed in Croatia](#)

[Bacterial communities as indicators of environmental pollution by POPs in marine sediments](#)

[Global distribution of two polystyrene-derived contaminants in the marine environment: A review](#)

OCCUPATIONAL

[Contamination and washing of cloth masks and risk of infection among hospital health workers in Vietnam: a post hoc analysis of a randomised controlled trial](#)

[Exposure to Radiation During Work Shifts and Working at Night Act as Occupational Stressors Alter Redox and Inflammatory Markers](#)

[Assessment of chromosomal aberrations among agricultural workers exposed to pesticides in Punjab, India](#)

PHARMACEUTICAL/TOXICOLOGY

[Formaldehyde exposure induces regulatory T cell-mediated immunosuppression via calcineurin-NFAT signalling pathway](#)