

# Bulletin Board

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

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## Regulatory Update

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### ASIA PACIFIC

#### Japan mulls changes to safety data sheet requirements

2020-05-28

The Ministry of Health Labour and Welfare (MHLW) has discussed a raft of proposals to encourage more transparent exchange of mandatory and voluntary chemical hazard information.

Materials released by the ministry ahead of a meeting today point out that substances with no legal requirement for safety data sheets (SDSs) were responsible for as many as half of all accidents involving acute toxicity from chemical exposure.

The Industrial Safety and Health Act (ISHA) is the main law implementing the Globally Harmonized System (GHS) of classification and labelling of chemicals in Japan. This obliges companies to provide SDSs and labels for 673 substances and their mixtures up to certain thresholds.

Although the ISHA also encourages companies to provide SDSs for other chemicals that might pose physical or health hazards, this is not a legal requirement. The ministry reports that only 60–70% of businesses regularly share hazard documents when not legally obliged to.

The MHLW acknowledges that certain chemicals with potential long-term adverse health effects currently have no mandatory hazard warning requirements, including approximately 200 category 2B carcinogens, which are substances considered to be “possibly carcinogenic to humans” by the International Agency for Research on Cancer (IARC).

Proposals to expand the legal requirements for SDSs and labelling of chemicals were limited to substances involved in accidents from adverse reactions of improperly labelled mixtures.

#### Voluntary action

However, the MHLW is instead considering steps to promote a culture of voluntary SDS circulation among businesses in Japan, in particular among small and medium sized enterprises with fewer human resources available to manage compliance issues.

The ministry has already developed model SDS documentation and labels for companies to use, which cover 3,014 substances.

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It now plans to expand on these resources to cover more substances, with priority given to chemicals imported or produced in Japan in large quantities.

Other suggested measures include providing a budget for training and consultancy services to ensure that smaller businesses are meeting their compliance requirements.

Also, SDSs and labels for transfers of consumer products, which are generally not required, might become necessary when those products are purchased in business-to-business transactions.

It is also considering technology-based solutions to enable sharing of SDS documents online with QR-coded labels.

Chemical Watch, 28 May 2020

<https://chemicalwatch.com/120630/japan-mulls-changes-to-safety-data-sheet-requirements>

22 October 2019

#### New tailored guidance pathways available

2020-05-28

28 May 2020

We've published two new tailored guidance pathways on our website:

- I want to vary the use of a product to include a new use, new application method, or new use instructions within an existing crop or situation (agricultural chemical products only).
- I want to register a product and apply for the concurrent approval of a new source of active.

Designed to make the registration process easier and more efficient, our tailored guidance pathways provide the information you need to lodge the right application, with the right data and supporting evidence to meet APVMA criteria, before entering our Online Services Portal.

Learn more about [tailored guidance for applicants](#), and view the complete list of pathways available.

APVMA, 28 May 2020

<https://apvma.gov.au/node/68196>

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### AMERICA

#### Listen to experts and tackle the toxic chemical crisis contributing to chronic disease

2020-05-28

Infectious disease experts, scientists, and doctors have warned about the potential for a pandemic for years. Microsoft founder Bill Gates did a TED Talk on it and U.S. intelligence agencies knew it was a real threat. There was even a major USAID program, recently de-funded, called Predict, designed to head off pandemics.

And now, these scientific warnings have come true.

The once invisible threat of a virus spreading throughout our country is painfully visible today. Given a choice, wouldn't we all choose to prevent the spread of this horrible virus in the first place?

It's too late to stop COVID-19 from entering our lives. But there is another invisible threat to our health and well-being we can address.

Similar to those who cautioned us about a disease like COVID-19, leading public health experts, scientists, and doctors today warn us that exposure to toxic chemicals is contributing to rates of chronic illnesses.

Many of these chemicals are found in the air we breathe, the water we drink, and the products in our homes. And many of these illnesses worsen the impacts of COVID-19.

Experts have been calling attention to these invisible threats for decades. Meanwhile, companies are still putting harmful chemicals into the products they make.

More than 20 years ago, Dr. Pete Myers and Dr. Theo Colburn co-authored *Our Stolen Future*, explaining the science behind how synthetic chemicals interfere with hormonal action in people. Interfering with your hormones can cause a long list of health problems, including impairing your resistance to disease.

Dr. Linda Birnbaum, over her decades-long career, including as director of the National Institutes for Environmental Health, has been at the forefront of building the overwhelming scientific case revealing the toxic chemical crisis and its harmful impacts on public health. Recently, she pointed out that endocrine-disrupting chemicals "increase the diseases that cause the underlying conditions that result in susceptibility to COVID-19."

**Many of these chemicals are found in the air we breathe, the water we drink, and the products in our homes.**

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Your family, friends, and neighbors are more vulnerable to the novel coronavirus if their defenses have been compromised by chronic illnesses like cancer, diabetes, or asthma. And scientific experts have found these and other health problems are all linked to exposure to toxic chemicals.

For example, chemicals called PFAS (per- and polyfluoroalkyl substances) are linked to many chronic illnesses as well as suppression of the immune system. And yet they are still commonly used for stain resistance and water repellency in millions of consumer products, such as carpets, food packaging, and furniture. A Harvard study found millions of people in the U.S. are drinking unsafe levels of PFAS in their water.

Our existing federal regulatory systems are failing us by allowing hazardous chemicals to contaminate people and the planet. Current laws allow the most dangerous chemicals to be used in everyday consumer products—from cosmetics and clothing to electronics and home furnishings.

If we've learned anything from our current crisis, it's that we must heed the advice of health and medical experts. We must aggressively invest in prevention, safer alternatives, and our public health infrastructure. We need to build healthier and more resilient communities as a key step dramatically reducing people's exposure to harmful chemicals must be a public health priority.

We know how to do this. States are already leading the way.

In the efforts to flatten the curve on COVID, states like Washington, Oregon, and California collaborated early on an aggressive strategy. Similarly, these and other states have also been in the lead in flattening the curve on the most hazardous chemicals put into products.

These governors, along with their states' legislative leaders, have been committed to taking preventive measures that build healthier communities through stricter regulation of hazardous chemicals put into products.

The state of Washington has adopted the strongest chemical laws in the nation. This includes the phaseout of toxic PFAS chemicals in certain products and a comprehensive law regulating endocrine disruptors, carcinogens, and neurotoxic chemicals in a wide range of products.

In Oregon, the Toxic-Free Kids Act targets harmful chemicals of concern in children's products, requiring disclosure and an ultimate phaseout of the chemicals.

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JUN. 05, 2020

California has long been a leader with broad policy regulating chemicals in products and, more recently, adopted strong restrictions on toxic chemicals in furniture.

The Hill, 28 May 2020

<https://thehill.com/opinion/healthcare/499952-listen-to-experts-and-tackle-the-toxic-chemical-crisis-contributing-to>

### Mexico's industry body working on alternative chemicals management proposal

2020-05-27

Mexico's chemicals industry body is developing an alternative chemicals management proposal to the one presented by the country's health authority, in collaboration with international trade associations.

In a 4 May notice, Aniq said it is seeking a regime that would allow its members to trade internationally and avoid "commercial barriers".

Mexico's General Health Council (CSG) proposed an overarching national chemicals policy late last year that would place the burden of proof on companies to show substances they import or use in the country are safe, and allow the government to restrict or ban those that pose an "unacceptable risk" (see box).

But the proposal generated "a certain degree of curiosity and concern" among industry organisations, Aniq's notice said. It did not respond to Chemical Watch's request to expand on these concerns, but the trade association has previously highlighted the proposal's divergence from the agreement made in the United States-Mexico-Canada Agreement (USMCA) to align chemical risk management measures across the North America region.

Aniq has now formed a working group for its member companies to develop an alternative proposal that "at least conceptually, develops a new mechanism for the management of chemicals in Mexico".

It is discussing this with representatives from the International Council of Chemical Associations (ICCA) and the American Chemistry Council (ACC), it said. The associations have agreed to consult with Latin American trade bodies "in order to comment on it and define a joint agenda that will allow the chemical industry sector to improve the management of chemical substances."

**But the proposal generated "a certain degree of curiosity and concern" among industry organisations, Aniq's notice said.**

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### Cooperation strategy

The ACC and ICCA have suggested implementing a "cooperation strategy for the regulation of chemical substances in Latin America", according to the notice. The ICCA would coordinate this, providing training courses for companies and governments in the region, facilitating information exchange and financing an expert adviser.

The associations would also hold monthly meetings to discuss next steps for the strategy, it said, adding that these meetings could also lead to the development of regional position papers for international processes like the Strategic Approach to International Chemicals Management (Saicm).

The ACC declined to comment on the cooperation strategy or its position on Mexico's proposal. It reiterated its previous statement that a risk-based approach to regulating chemicals "is the preferred approach throughout North America."

Aniq did not respond to requests for comment in time for publication.

The ICCA, Unep and others have hosted two workshops for Latin American industry associations and governments, with the aim of developing "homogenised regulatory frameworks" in the region. The latest was hosted in November 2019.

Chemical Watch, 27 May 2020

<https://chemicalwatch.com/120636/commission-amends-eu-pic-regulation-to-add-biocidal-substances>

### EPA disagreed with White House on updating mercury analysis

2020-05-29

The EPA disagreed with a White House request to use current data when revising its rule on mercury air pollution, publicly available email exchanges show, which a law professor says could weaken the agency's legal defense of the regulation.

The regulation involved a second look at the Obama administration's legal rationale to see whether it was "appropriate or necessary" for the Environmental Protection Agency to limit mercury and other toxic air pollution from power plants.

**But the emails show the current EPA said it wasn't obligated to do so under the Clean Air Act.**

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The Trump administration's EPA concluded May 22 the mercury and air toxics standards, known as MATS, which were set in 2012 and met subsequently by the power sector, weren't justified. It reached this decision by using the same health benefits and compliance estimates used in 2012 to set the standards.

The White House Office of Management and Budget asked the EPA to update its cost-benefit analysis, using the most recent findings on actual health benefits of reducing mercury, a known neurotoxin, as well as the costs that power plants incurred since 2012 to meet those limits.

But the emails show the current EPA said it wasn't obligated to do so under the Clean Air Act.

The EPA's rationale may fail under the Administrative Procedure Act, which bars federal agencies from making arbitrary decisions, said Melissa Luttrell, a University of Tulsa Law School professor. She said the emails show the agency simply chose not to use updated direct benefits and direct costs of reducing mercury and other targeted air pollutants.

"These emails make it really clear that a shoddy procedure was followed," Luttrell told Bloomberg Law. "They show that EPA is not considering all the factors that it is statutorily required to consider."

The EPA, for its part, said it doesn't comment on the interagency process, but defended its regulation in an email to Bloomberg Law. It said the rule, as finalized, "properly evaluates" the compliance cost to coal- and oil-fired power plants and the benefits from reducing hazardous and air pollutant emissions from those power plants.

"Those power plants remain subject to and must comply with the mercury emissions standards of the MATS rule, which remains fully in effect notwithstanding the revised cost-benefit analysis," the agency said in the email.

Bloomberg Law, 29 May 2020

<https://news.bloomberglaw.com/environment-and-energy/epa-disagreed-with-white-house-on-updating-mercury-analysis>

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### EUROPE

#### Plant protection products Regulation lists of approved active substances updated

2020-05-27

The following substances have been added to the list of approved active substances under the Plant protection products Regulation (EC) No. 1107/2009 as per Commission Implementing Regulation (EU) 2020/642 of 12 May 2020 and Commission Implementing Regulation (EU) 2020/646 of 13 May 2020:

1. L-cysteine hydrochloride
2. L-cysteine hydrochloride monohydrate
3. Lavandulyl senecioate

As a result, these substances have now been updated in the list of approved active substances (the Annex to Commission Implementing Regulation (EU) No. 540/2011).

Yordas Hive, 27 May 2020

<https://www.yordashive.com/news/article/918>

#### Commission amends EU Pic Regulation to add biocidal substances

2020-05-28

The European Commission has adopted amendments to the prior informed consent (Pic) Regulation on the export and import of hazardous substances, to add several biocidal active substances to Annex I.

Annex I lists substances that are subject to the export notification or Pic procedures, and those qualifying for Pic notification. The EU executive has to review them at least once a year.

The substances are:

- the fungicides thiram and propiconazole; and
- the neonicotinoid insecticides clothianidin, thiamethoxam and imidacloprid.

They are approved under the biocidal products Regulation (BPR). However, the Commission has decided not to renew their approvals under the plant protection products Regulation (PPPR).

**The EU executive has to review them at least once a year.**

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It published the amendments on 15 May after a public consultation ended on 13 March.

They will enter into force 20 days after publication in the EU's *Official Journal*.

Comments received during the consultation informed on the importance of clothianidin for malaria vector control in third countries, it said.

In addition, the pesticide phorate and brominated flame retardant hexabromocyclododecane have been added to Annex I, following a decision last year to include them in Annex III of the Rotterdam Convention, which EU Pic implements.

Hexabromocyclododecane is already listed in Annex V and thus banned for export. This annex has also been amended to reflect EU export bans on mercury.

Chemical Watch, 28 May 2020

<https://chemicalwatch.com/120636/commission-amends-eu-pic-regulation-to-add-biocidal-substances>

### Hand sanitiser products and surface disinfectants during the coronavirus outbreak—use, manufacture and supply

2020-05-28

During the coronavirus (COVID-19) outbreak, there is increased demand for hand sanitiser and surface disinfectant products.

HSE has guidance for employers who are providing hand sanitiser for their workers and others to use in their workplaces, and for existing and new manufacturers of hand sanitisers and surface disinfectants. The guidance about choosing hand sanitiser may also be useful to members of the public.

There is guidance on:

- choosing the right hand sanitisers and surface disinfectants
- manufacturing and supplying hand sanitisers (PDF)- Portable Document Format
- manufacturing and supplying surface disinfectants (PDF)- Portable Document Format

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HSE's response to increased demand for the manufacture and supply of biocidal hand sanitiser products during the coronavirus outbreak

UK HSE, 28 May 2020

<https://www.hse.gov.uk/news/hand-sanitiser-surface-disinfectant-coronavirus.htm#>

## INTERNATIONAL

### Emergency responses for the supply of disinfectant against Covid-19

2020-05-27

The COVID-19 pandemic calls for urgent policy responses to support the supply of disinfectant products such as hand sanitisers and wipes. The OECD is collecting and providing available information in countries to manage the emergency supply to increase availability of disinfectant products from different competent authorities and industry organisations. As the situation is fast evolving, countries are submitting information on a rolling basis.

OECD, 27 May 2020

<https://www.oecd.org/env/ehs/pesticides-biocides/emergency-responses-for-the-supply-of-disinfectants-against-covid-19.htm>

### ChemSec and Clearya partner to help online shoppers avoid toxic chemicals in daily products

2020-05-27

The COVID-19 outbreak and social distancing practices adopted in many countries are affecting the way people shop. While brick and mortar shops are struggling, online shopping is on the rise. When people are concerned of potential exposure to coronavirus inside crowded shops, new online shopping habits are created and reinforced over time.

The pandemic is increasing public awareness of environmental contaminants and their impact on people's health. These contaminants include air pollution, but also certain carcinogenic compounds and endocrine disruptors still used in cosmetics and other consumer goods, contribute to the development of underlying health conditions that may increase susceptibility to coronavirus.

**As the situation is fast evolving, countries are submitting information on a rolling basis.**

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In response to the COVID-19 crisis, ChemSec, the International Chemical Secretariat, and Clearya, the safe online shopping app and browser plugin, are partnering in helping online shoppers avoid toxic chemicals in daily products.

ChemSec is a non-profit environmental organization established 18 years ago to drive the change to safer chemicals. Its SIN (Substitute It Now) List is a compilation of nearly 1,000 hazardous chemicals used around the world today, which should be avoided in the global supply chain because they fulfill the criteria for "Substances of Very High Concern" as defined by the EU chemicals regulation. The SIN List is available on the ChemSec website and serves sustainable brands and manufacturers in replacing these chemicals with safer alternatives, even before mandated to do so by the regulation.

Clearya is a free web browser extension and a mobile app that helps people reduce exposure to toxic chemicals, while shopping online for cosmetics, personal care, cleaning products and baby care products. Clearya works by automatically analyzing the product ingredient lists at major online shops, and notifying the shoppers if any of the ingredients matches a known toxicant, according to authoritative regulatory or scientific sources.

This new collaboration adds the ChemSec SIN List to Clearya, which makes important ingredient safety information available to consumers right as they browse potentially unsafe products at major online shops.

*"You shouldn't have to be a trained chemist to be able to spot and avoid products containing harmful chemicals. That's why we are very pleased that Clearya has taken our SIN List and made it useful to all consumers out there," says Dr. Anna Lennquist, Project Manager for the SIN List at ChemSec.*

Amit Rosner, founder of Clearya, added: *"The partnership between ChemSec and Clearya comes at a pivotal moment when people are ready to change consumption habits and embrace safer alternatives. I'm thrilled to join forces with ChemSec in empowering consumers in their transition to healthy living."*

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Clearya browser extension is available on the Chrome Web Store for computers, and on the Apple App Store for iPhone, and Google Play for Android.

prnewswire.com, 27 May 2020

<https://www.prnewswire.com/news-releases/chemsec-and-clearya-partner-to-help-online-shoppers-avoid-toxic-chemicals-in-daily-products-301065769.html>

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## REACH Update

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### Poison centres quick access to accurate information saves lives

2020-05-29

More than half a million calls are made to European poison centres every year. In some countries, poison centres respond mainly to questions from healthcare professionals. In others, they give direct advice to concerned citizens. In both cases, quick access to accurate information is a must. Three experts working for national authorities tell how they expect the new information requirements to help poison centres and what companies should keep in mind when preparing their notifications.

To improve the protection of citizens across the EU and ensure a level playing field for companies, harmonised information requirements for notifying hazardous mixtures under the Classification, Labelling and Packaging (CLP) Regulation start to apply from 1 January 2021. This will replace the national implementations of the regulation that will be in place until then.

*Mette Ekeland, Senior Adviser at the Norwegian Poisons Information Centre welcomes the change as information is key when it comes to poison centre work. "Our average call time is four minutes. During this time, we have to find out what has happened, find information on the product, make an assessment of what needs to be done and explain this to the caller. To manage all this in such a short time, we need immediate access to product information," she explains.*

ECHA Newsletter, 29 May 2020

<https://newsletter.echa.europa.eu/home/-/newsletter/entry/poison-centres-quick-access-to-accurate-information-saves-lives>

### PFAS—but at what cost?

2020-05-29

A class of synthetic chemicals called **per- and polyfluoroalkyl substances (PFAS)** have been around since the 1940s, making our lives convenient with their anti-stick and stain-resistant properties. But the comfort they bring comes with a price. Due to their extremely strong molecular bonds, PFAS are difficult to break down and can accumulate over time in the environment and in our bodies. We spoke with experts from ECHA and the European Commission who explained why PFAS need to be regulated.

#### The chemistry behind

**In both cases, quick access to accurate information is a must.**

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PFAS are a large group of chemicals containing more than 4 700 individual substances. Their properties vary due to their diversity, but they all have one common element – they contain fluorine atoms, which build notoriously tough-to-break carbon-fluorine bonds. The longer the PFAS chains are, the more difficult they are to degrade.

*"This very stable molecular bond is what makes these chemicals so useful but at the same time also problematic. When used, for example, in firefighting foams they remain stable while helping to suffocate the fire from oxygen. But when released to the environment, their stability becomes an issue as nothing in the environment can break the carbon-fluorine bond," says Peter Simpson, a Senior Scientific Officer at ECHA.*

Due to their persistency, wide distribution and because their removal from the environment and our drinking water sources is not feasible, PFAS are sometimes referred to as forever chemicals.

#### How PFAS are currently regulated

Two of the most extensively used PFAS are already globally regulated. *Perfluorooctane sulfonic acid (PFOS)* and its derivatives have been restricted in the EU and EEA for more than a decade under the Persistent Organic Pollutants (POPs) Regulation. They have also been included in the Stockholm Convention to eliminate their use globally since 2009.

*Perfluorooctanoic acid (PFOA), its salts and PFOA-related compounds* have been listed in the Stockholm Convention since May 2019 and will also be restricted under the POPs Regulation as of 4 July 2020. In addition, there are plans to include *perfluorohexane sulfonic acid (PFHxS), its salts and PFHxS-related compounds* in the Stockholm Convention.

Although it is not yet possible to say if these actions have had significant effects on reducing the environmental burden of these chemicals, companies have started to replace the regulated chemicals with different types of PFAS. *"This too raises some concerns as even if the substitutes are not as toxic as the regulated PFAS, they may also be very persistent in the environment and may have some yet unknown toxic effects," Mr Simpson explains.*

*"As long as we continue using these chemicals, we will continue facing the challenge of how to contain their release," says Johanna Peltola-Thies, also a Senior Scientific Officer at ECHA. Therefore, further regulatory measures are urgently needed to prevent other PFAS from accumulating in the environment and affecting future generations. "Some subgroups of PFAS*

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are already scientifically proven to be toxic. For others, there are strong indications that point towards them also being toxic, but we need to explore this further," Ms Peltola-Thies adds.

So, work on PFAS needs to be accelerated to address potential issues related to their use. "Our work on PFAS started in 2012 with a very conventional, substance-by-substance risk management approach. In 2014, we realised that if we continued at the same pace, it will take many years to look into all of them, and possibly conclude that they all cause the same sort of concern. So, we moved to an approach that looks at PFAS subgroup-by-subgroup. This has also proven to be slow. So, there needs to be a more ambitious way of looking at a whole group of substances, and this is what Member States have been asking the European Commission to do," Mr Simpson points out.

### PFAS know no boundaries

Some Member States are worried about the wide spread of PFAS in the environment and their occurrence in soil. But the enormous contamination of water resources including surface and ground waters is also a cause for concern. "The Commission agrees that there is an urgent need to address the use of PFAS in the EU to prevent further emissions," says *Cristina de Avila*, Head of Unit of Sustainable Chemicals in Directorate-General for Environment of the European Commission.

And PFAS are everywhere, making them a global issue. "They are found in the bloodstream of European citizens, irrespective of their nationality. They are also found in wildlife, and everywhere in the environment – even in very remote places. This is because PFAS can be mobile and they can move between water, soil and air, making them present in all parts of the environment," Ms de Avila points out.

There are still several question marks related to the way forward. "One thing is clear – through our actions we need to guarantee the same level of protection for environments across Europe and to all citizens, but we also want to make sure that there is a level-playing field for the internal EU market," Ms de Avila explains.

### Are they in our food?

Concerns about PFAS are not only limited to industrial chemicals, they are also high on the agenda of the food sector.

"There are a number of activities on food and drinking water related to PFAS. The European Food Safety Authority (EFSA) has recently updated its

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risk assessment for PFOS and PFOA in food and extended its assessment to PFHxS and *perfluorononan-1-oic acid (PFNA)*. A mixture approach has been used to set a group tolerable weekly intake on the basis of the identified critical effect linked to exposure to PFAS in animals and humans. The draft opinion has undergone public consultation and the adoption of the final version of the opinion is expected later in 2020," tells *Veerle Vanheusden*, Policy Officer in Directorate-General for Health and Food Safety of the European Commission.

For drinking water, the European Parliament and the European Council recently agreed to include PFAS in the recast of the Drinking Water Directive. "As a consequence, 20 PFAS chemicals will need to be monitored and kept below a certain threshold in all drinking water in the EU," Ms de Avila adds.

### Where are we heading?

It is clear that PFAS have unique functions. They continue to be used because they offer comfort and convenience. But since there is no fundamental societal need for many of their uses, the first step towards limiting their use is to distinguish between essential and non-essential uses.

"This will require consumers to change their mindset. We all need to understand which products contain PFAS and what their risks are. For critical applications, such as medical devices, we need safer alternatives that achieve the required performance before we can phase out PFAS," Ms de Avila points out.

Although some of the issues related to PFAS have already been addressed, EU Member States are calling for the Commission to develop a coherent, consistent and comprehensive approach to deal with PFAS. In December 2019, the Netherlands, Denmark, Germany and Sweden sent the Commission a document called Elements for an EU-strategy for PFAS that lays out a strategy to phase out most uses of PFAS compounds by 2030. In addition, the Netherlands and Germany, with support from Norway, Denmark and Sweden, have shown interest in preparing a restriction proposal to cover a broad range of PFAS uses.

"We, in the Commission, are committed to addressing PFAS and we are considering how to make the suggested EU-strategy for PFAS a part of the chemicals strategy for sustainability, which we are planning to publish later in 2020," Ms de Avila tells.

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"We have to address these chemicals as a group rather than individually, not only to speed up the process but also to help avoid regrettable substitution. The work on PFAS is one way to prove that we are living up to our ambitions under the Green Deal and that we really do have a holistic approach to achieving, in practice, a toxic-free environment for the Union," Ms de Avila concludes.

ECHA Newsletter, 29 May 2020

<https://newsletter.echa.europa.eu/home/-/newsletter/entry/pfas-convenience-but-at-what-cost->

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## Janet's Corner

JUN. 05, 2020

### Eclipse

2020-06-05

Paramecium Parlor

@AmoebaSisters



~<https://www.amoebasisters.com/parameciumparlorcomics/happy-solar-eclipse-2017-day>

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## Hazard Alert

JUN. 05, 2020

### Hydrazine

2020-06-12

Hydrazine is a colourless, fuming oily liquid, with a strong ammonia-like odour. It is dangerously unstable and highly toxic, unless handled in a solution. It occurs naturally as a by-product of microbial nitrogen fixation, and has been found in tobacco smoke. It can also be released into the air during venting operations. Hydrazine has been classified as carcinogenic to human health. [1,2,3,4]

### USES [1,2,4]

Hydrazine is used across chemical industries as an ingredient in blowing and foaming agents, propellants, and pharmaceutical products. It is used as a precursor to blowing agents and pesticides, and as an ingredient in rocket fuel. Hydrazine is used as a component in some antidepressants.

### ROUTES OF EXPOSURE [3]

- Exposure to hydrazine may occur accidentally or occupationally.
- Exposure can be from hydrazine-based drugs, or from tobacco.
- Workers can also be exposed to the chemical through the handling of propellants or fuel.
- The general public can be exposed to hydrazine from a chemical spill.

### HEALTH EFFECTS

Hydrazine poisoning affects a range of systems including the integumentary, respiratory and nervous systems.

### Acute Effects [3]

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

- Skin contact with hydrazine can result in severe contact dermatitis and burning eyes, with possible eye damage.
- Inhaling the chemical can irritate the nose, throat or lungs. It can also cause pulmonary oedema.
- Exposure to hydrazine can cause nausea, vomiting, seizures, dizziness, convulsions and headaches.

**Hydrazine is a colourless, fuming oily liquid, with a strong ammonia-like odour.**

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## Hazard Alert

JUN. 05, 2020

### Chronic Effects [4]

Hydrazine is toxic to multiple body systems. Long-term exposure to the chemical can result in cancer. Although there are no long-term studies looking at the effects of hydrazine on humans, animal studies have found that hydrazine caused liver, nasal cavity and lung cancer in animals. Hydrazine may affect reproductive health. Long-term exposure could result in a skin rash, which may be triggered by low dose exposures in the future. Repeated exposure of the chemical can result in bronchitis, anaemia or long-term damage to the kidneys or liver.

### SAFETY

#### First Aid Measures [1]

- Ingestion: DO NOT INDUCE VOMITING. Rinse mouth, but do not give them anything to drink. Immediately contact a medical professional.
- Skin contact: Immediately wash affected skin with water for at least 15 minutes—then remove contaminated clothing. Do not re-wear until it has been thoroughly de-contaminated. Continue rinsing contaminated skin. Contact a healthcare professional.
- Eye contact: Check for and remove contact lenses if easy to do so. Rinse eyes carefully with water or normal saline solution for 20-30 minutes. Take the victim to a medical centre.
- Inhaled: Take victim to the nearest fresh air source and monitor their breathing. Allow them to rest and contact a medical professional.
- General: Never administer anything by mouth to an unconscious, exposed person.

#### Exposure Controls/Personal Protection [5]

- Engineering controls: Emergency eyewash fountains and safety showers should be accessible in the immediate area of the potential exposure. Ensure there is adequate ventilation. Whenever possible, material should be handled in a laboratory.
- Personal protection: Safety glasses (indirect-vent, impact and splash resistant), protective and dustproof clothing, glove, an apron and an appropriate mask.

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## REGULATION [6]

## United States:

The Occupational Safety and Health Administration (OSHA) has set an 8-hour time weighted average (TWA) concentration for hydrazine of 1ppm.

## Australia [3]

Safe Work Australia has set an 8-hour time TWA for hydrazine of 0.01ppb.

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## New helmet and tent aim to protect health care workers from the coronavirus

2020-05-15

COVID-19 is a threat to the very people fighting it—nurses, doctors, and other first responders, who are exposed to virus-carrying droplets, or aerosols, from infected patients. Now, a team has developed two devices that could reduce their risks by sucking away infectious aerosols: a helmet to be worn by a patient, and a small tent in which a patient could be enclosed. The devices haven't been proved to work in clinical settings, but their inventors hope they'll reduce the toll among health care workers, at **least 90,000 of whom** worldwide have been infected with COVID-19, according to the International Council of Nurses.

Talking and coughing can expel virus-carrying droplets, and medical procedures needed for the sickest COVID-19 patients—such as intubation, tracheostomy, and cardiopulmonary resuscitation—are thought to generate **even more aerosol droplets**. The tent and helmet would capture them with negative pressure, generated by a pump that draws exhaled air through filters, researchers reported yesterday in the *International Journal of Tuberculosis and Lung Disease*.

Negative-pressure rooms have been used in hospitals since the 1980s to keep airborne germs from spreading. But such rooms cost about \$120,000, says Nathan Haas, an emergency medicine physician at the University of Michigan (UM), Ann Arbor. He and his colleagues wanted to develop a cheaper way to create a negative pressure environment for patients. The new devices could lower the need for negative-pressure rooms, which are scarce in many parts of the world, Haas says.

That could benefit patients as well as those who treat them. Fear of infection leads many hospitals to forgo therapies that could help COVID-19 patients but release a lot of aerosols, such as noninvasive ventilation with masks and oxygen delivery via nasal tubes, according to the authors. Instead, doctors resort to mechanical ventilation, which is harder on patients but doesn't produce as many aerosols after the initial intubation step.

The **helmet can be used** when staff transport patients, Haas says; **the tent can enclose the upper body** of a bed-bound patient wearing a mask and allows staff to perform several procedures that release droplets.

"They represent a really simple solution to ... potentially help with reduce virus transmission and increase the safety of health care workers, as well as

**The new devices could lower the need for negative-pressure rooms, which are scarce in many parts of the world, Haas says.**

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patient safety," says Ben Bassin, an emergency medicine physician at UM and member of the research team.

To produce the prototypes, the researchers teamed up with FlexSys Inc and DEKA, companies that are now preparing to scale up production. The team hopes to get U.S. Food and Drug Administration approval for both devices by the fall and commercialize them by the end of the year. They estimate the helmet will cost less than \$150.

When the researchers tested their devices with a healthy volunteer, they saw 97% to 99% fewer particles outside the devices than inside. They also tested the devices' ease of use and comfort with seven COVID-19 patients. The feedback from patients and staff was good, Bassin says.

But Reuben Strayer, an emergency physician at Maimonides Medical Center in New York City, notes the tests did not prove that these devices work to protect medical staff in real-life situations. He says he wants to see independent validation "to see if they perform as they are advertised."

If they do work, he adds, "We would like to have these devices in use as soon as we can. The earlier that we can have access to better devices to take care of patients and to protect staff, the better."

sciencemag.org, 15 May 2020

<https://www.sciencemag.org>

### Scientists find hope for reefs battered by climate change: Bahamas coral that survive hot seas

2020-05-24

A team of scientists looking for coral that can better survive global warming have identified a hardier Caribbean coral in the Bahamas.

The mountainous star coral off Great Harbour caught researchers attention after a searing 2015 bleaching event hit reefs across the islands. As water temperatures on Mermaid Reef soared above 91 degrees, the coral survived. Just a dozen miles away, similar star coral in cooler water died.

The finding, published in the journal *Coral Reefs*, could help researchers trying to breed more heat resilient coral in labs as they race to save reefs that have lost about 80 percent of their coral since the 1970s.

"This reef is one place that's teaching us about what naturally resilient corals look like," said co-author and Shedd Aquarium coral researcher Ross

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Cunning. "We can use corals like these to optimize restoration efforts like growing corals in nurseries...to produce a new generation of corals."

The reef tract along Florida, the only inshore tract in the continental U.S., has been hit hard in recent years. A disease that appeared off Virginia Key in 2014 has now spread south to the Keys and deep into the Caribbean, reaching as far south as Belize and east as the Dutch Antilles. Researchers suspect the disease may be spread by ballast water, but temperatures may also play a role.

The stony coral disease also coincided with back-to-back bleaching events and the largest and longest bleaching event on record that slammed reefs around the planet.

Coral scientists have been trying to buy time for the reefs by replanting fast-growing staghorn coral grown in nurseries. But a study this month that looked at replanted Keys coral found that although the coral did well initially, they eventually succumbed to the same stresses that killed wild staghorn. Fewer than 10 percent of the corals survived beyond seven years.

That puts more urgency on efforts to raise more heat-resistant coral like the kind being researched at the University of Miami, where researchers at the Rosenstiel School of Marine and Atmospheric Science have been focusing on the algae that live inside the coral. In healthy coral, the algae photosynthesize to provide them with food. When temperatures get too high, the algae can instead start producing toxins so coral expel them.

In the Bahamas, star coral live with just four different kinds of algae that can provide some heat tolerance.

"Corals are an animal and they have this really great partnership with micro-algae," said Katie Parker, the study's lead author.

The team found that the star coral on Mermaid Reef not only lived with a specific algae, but an algae that belonged to the same family. They also found the coral themselves were genetically identical to each other, Parker said.

"An easy way to kind of explain this is if you relate it to humans. We're all the same species. We're all humans. But some of us are tall and some of us are short. And that's because of a specific gene that we have," she said. "It can be the same way with corals, where they're all the same species of corals. But some are more thermally tolerant and some are not because of the genes that they have."

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That combination led them to tolerate the higher temperatures while the nearby reef where coral died had more diverse coral and a greater diversity of algae. It's likely repeated bleaching events, and evolution, led to only the hardiest surviving on the shallow reef.

"That means that new coral that could have drifted in, that were a different type, didn't have the right genes to fit in there. So they didn't survive," she said. "So over time, this environment has become this place that only this kind of specific kind of coral genes can fit in and stay alive."

Identifying the coral and the algae can help lab breeders, but Parker and Ross said much work remains. Getting coral to breed is complicated and coaxing them into living with a specific algae is still a work in progress. Earlier this month, Australian scientists said they had identified 10 different heat-tolerant algae, but researchers still need to crack the code of getting the right coral with the right algae that are also willing to grow in different locations.

Successful reefs also need diversity, Cunning said.

"We want reefs that have lots of different genetic types of coral. Some that are more heat tolerant, some that grow quickly," he said. "But as an ecosystem, as a coral reef, it will have the highest resilience if it has high genetic diversity. So we want to make sure to preserve that genetic diversity. We can't have the reef entirely composed of one type of coral because then whatever negatively impacts that coral could destroy the whole system."

wlrn.org, 26 May 2020

<https://www.wlrn.org>

**Less than 10% of all plastic trash ever produced has been recycled. Is this the breakthrough we've been waiting for?**

2020-05-21

Plastic. It's not hard to see how anyone who is appalled at the despoliation of the environment could think that the world would be better without it. Nearly 10% of the world's oil is used in making it. It has enabled the proliferation of cheap goods — cramming closets, landfills and otherwise-unspoiled places where it could remain for decades, if not centuries.

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Yet, because it's so much lighter than the steel and glass it has replaced in vehicles and elsewhere, plastic has massively reduced fossil fuel emissions. And in the midst of a global pandemic, the need to securely protect food and personal items with impermeable packaging is essential.

Like it or not, plastic is going to be with us for a while. Can we learn to get along?

Conventional recycling, in which waste plastic is collected, sorted, cleaned, shredded, and then melted down and pelletized to be reused, has the potential to ameliorate the problem — except that it isn't working. Less than 10% of all the plastic trash ever produced has been recycled. There are a lot of reasons for this, but most of them come down to the question of value. That's because every time plastic is recycled in this manner, it loses value.

But there is good news on this front: chemical recycling. Sometimes known as advanced recycling, it's a process that decomposes plastics to basic components called monomers, or even further into simpler compounds, removing impurities, then reassembling these ingredients into virgin plastic that is indistinguishable from new. With chemical recycling, items that previously were being downcycled can now be turned into constituent materials that can be recycled indefinitely with no loss in clarity, quality or performance.

A number of companies, large and small, are already doing this in different markets with different types of plastics.

#### **Nylon: Carpet-Go-Round**

Nylon is used in a variety of applications, from tires, to rope, to durable car parts, to textiles and carpeting. It was the first plastic to be chemically recycled for two reasons. First, one common form of nylon, nylon 6, is made from a single monomer, called caprolactam, which makes the breakdown of polymers into constituent parts somewhat simpler. Second, nylon is a relatively expensive plastic, which makes the value proposition attractive.

The Italian company Aquafil developed a chemical recycling process for nylon 6 after several other companies had failed, according to CEO Giulio Bonazzi. Strongly motivated to develop an ecologically friendly way to produce nylon, Bonazzi started back in 2011 with the development of a process that converts waste nylon to virgin Econyl nylon through chemical

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depolymerization. The process uses a series of steps to break nylon into a resin that is indistinguishable from oil-based resin.

Aquafil's journey continued in 2013 with a collaboration with Healthy Seas [recovering nylon fishing nets from the ocean](#) to be recycled. In 2018, the company opened a carpet recycling facility in Phoenix, retrieving waste carpets collected under California's stewardship law. The carpets are processed into pellets that are shipped to Slovenia for final purification. Bonazzi says that even with the shipping cost, the process is generally cost-competitive with virgin nylon.

Aquafil has built a second carpet recycling facility in Woodland, California, and Bonazzi says it plans to build a processing plant in the U.S. Considering that perhaps [5 billion pounds](#) (2 billion kilograms) of carpeting go into landfills each year, this an opportunity to capture value that would otherwise literally go to waste. Interface and Tarkett are among the carpet makers using Econyl yarn.

### Polyester: Supply Chain Challenges

California-based [Circular Polymers](#) also recycles waste carpeting. The company extracts PET (a form of polyester) fibers, densifies them, then sends them to material producer [Eastman](#) in Tennessee. Eastman puts the fibers through its [carbon renewal technology](#) (CRT) process, which extracts the essential components from which new materials can be made. Eastman CEO Mark Costa says this arrangement, which began in November 2019, [will divert millions of pounds of carpeting](#) in its first year alone.

According to Tim Dell, vice president of innovation at Eastman, CRT can work with a wide variety of plastics except PVC. It uses steam at high temperature and pressure to break the plastics down into [syngas](#), "a mixture of carbon monoxide and hydrogen, the [reactive building blocks](#) of virtually all plastic packaging materials," Dell says. These building blocks can then be reassembled into new plastics and fibers.

Eastman has modified its process for producing cellulosic acetate, a type of plastic used to make eyeglass frames, buttons, cigarette filters and similar items, to allow it to accept chemically recycled material blended with virgin feedstock. Dell says they plan to feed 50 million pounds (20 million kilograms) of waste plastic into the process this year.

The process theoretically could be run entirely on waste plastic. However, says Dell, there currently isn't enough of the stuff available to feed into

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the system. "One of the biggest challenges we have is getting access to sufficient quantities of waste plastic feedstock," he says. "Basically, we have to build a new supply chain."

"We've converted this waste plastic from zero end-of-life value and are doing something that creates value," Dell says. "We have to do that to make the economics work." Right now, waste plastic is economically disadvantaged with respect to fossil fuels, despite the fact that's essentially free, because the supply chains are not robust, making it cheaper and easier to simply buy from the oil companies.

"Over time as those supply chains are developed, those costs will come down," Dell says.

Eastman recently signed an agreement with eyewear supplier [Mazzucchelli](#) to accept previously unrecyclable pre-consumer waste to process into new acetate. And it expects a [second advanced recycling process](#), which it calls [polyester renewal technology](#) (PRT), to come online in 2022. This process is specifically aimed at polyester-based plastics, such as PET, from which many types of plastic bottles are made. A lot of PET is being recycled, but much of it has been colored or contaminated, so it cannot meet performance standards. PRT breaks the polyester into its two base monomers: dimethyl terephthalate and ethylene glycol, and then turns them back into polyester building blocks, much as Aquafil does with nylon.

### Polyethylene: Bottles and Bags

So what about polyethylene (PE), the [cheapest plastic around](#), the one those pesky plastic bags, among other things, are made of? PE comprises [roughly one-third](#) of all plastic produced. And attempts to reduce its use are being thwarted today by COVID-19 concerns.

Some PE bags are collected at grocery stores and mechanically recycled into [simulated wood decking](#). But there are other options coming to the fore. A startup in Menlo Park, California, called [BioCellection](#) has come up with a chemical recycling process for polyethylene that takes a different approach.

"Polyethylene is cheap, but it contains a lot of valuable carbon," says BioCellection CEO and co-founder Miranda Wang. "The question is, how do you break that carbon out of its structure and turn it into something that people want?"

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BioCollection focuses on how to extract the most value from the waste materials. Wang described the two-step process that breaks PE down into intermediates known as dicarboxylic acids, then builds those back up into more valuable products such as polyurethanes and materials for 3D printing. Some of these can be sold for more than 100 times what the plastic itself is worth.

The company has an agreement with the city of San Jose, California, to receive plastic waste from the city's recycling stream. So, while these plastic bags are not being recycled into new plastic bags, they are being used to make something far more valuable than, according to Wang, will displace production processes that are more damaging to the environment.

#### Enough Scale to Make the Sale

The key to chemical recycling's success will lie in the value preserved in the material, but that will only attract interest if chemical recycling can be done at low cost.

It's clearly easier to move barrels of oil or send it through pipelines than to move mountains of plastic waste. That's a hurdle that recyclers must overcome. Capital expenditures are also high. But costs will fall with scale and infrastructure will improve — if the price is right. It's a classic chicken and egg problem. But the fact that so many companies are pursuing it strongly suggests that scale will be achieved.

According to Chemical and Engineering News, dozens of companies are developing chemical recycling technologies, some with very ambitious targets.

For example, U.K.-based Plastic Energy heats waste plastic in the absence of oxygen to generate oil from which either new plastic or oil can be made. The company is building a plant that will chemically recycle up to 30,000 metric tons (33,000 tons) of plastic per year and is planning several additional plants in Asia.

Loop Industries of Quebec recycles PET with a depolymerization process similar to Eastman's PRT and has partnered with the Thai company Indorama Ventures to build a 44,000-ton-per-year (40,000-metric-ton-per-year) plant in Spartanburg, South Carolina. Loop is supplying Coca-Cola, Danone and PepsiCo with recycled PET for their bottles. And California-based Brightmark is building a pyrolysis plant in

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Indiana that is expected to convert 100,000 tons (90,000 metric tons) of plastic waste per year into diesel, naphtha and wax.

While these numbers are still small relative to the 300 million tons (270 million metric tons) of plastic produced each year, the stage is now set for significant growth. Major players are also getting into the act, too. Dow is partnering with Fuenix Ecology Group with a goal of incorporating 100,000 metric tons (90,000 tons) of waste plastic into its production by 2025. And IBM is developing a catalyst-driven process for decomposing PET called VolCat that readily removes contaminants as it breaks the plastic into its constituent molecules.

While these numbers are still small relative to the 300 million tons (270 million metric tons) of plastic produced each year, the stage is now set for significant growth.

PureCycle Technologies is a subsidiary of Procter & Gamble that is chemically recycling polypropylene, with plans to process 60,000 tons (54,000 metric tons) per year. Chemical giant BASF is also moving into chemical plastic recycling, pursuing a pyrolysis approach.

Oil companies, concerned about reduced gasoline sales as the world shifts toward electric vehicles, are looking to plastic as way to replace some of the lost revenue. They will be competing, with their virgin feedstock, against recyclers in the plastics market. Shell, however, is hedging its bets, investing in its own pyrolysis recycling process. While that won't help the company unload its stranded assets, it will at least bring in some new revenue.

#### What About Carbon Emissions?

Because it involves more steps, chemical recycling can use more energy than mechanical recycling. Therefore, if the energy comes from fossil fuels, it would appear that chemical recycling could be worse from a greenhouse gas (GHG) perspective.

However, when you consider the entire life cycle of the materials, chemical recycling can be superior because mechanically recycled plastics degrade with each cycle and so eventually must be replaced by virgin material, which largely comes from fossil fuels. Chemically recycled plastics, on the other hand, can be reused indefinitely.

In addition, the production processes tend to emit less carbon than production of plastics from petrochemicals. Eastman says its CRT produces intermediates with 20–50% lower GHG emissions than the conventional

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petrochemical process. Likewise, it expects its PRT process to produce 20–30% fewer GHG emissions. According to think tank [CE Delft](#), as the plastics are broken down into more and more basic components, the greenhouse gas benefits decrease.

A study conducted by [Argonne National Lab](#) and reported in [Chemical and Engineering News](#) found that diesel fuel made from plastic waste produces up to 14% fewer GHG emissions than diesel made from crude oil. Furthermore, a [Dutch study by CE Delft](#) found that “chemical recycling can make a substantial contribution” to efforts to reduce greenhouse gas emissions.

The key to chemical recycling’s success lies in the fact that, unlike mechanical recycling, it adds value to the waste rather than downgrading it. It’s a bit like the legendary alchemists who turned lead into gold. Most recycling in the past, says Wang, has been costly with little in the way of financial pay-off, and has had to be dragged uphill, with lots of government support and mixed success. Chemical recycling is likely to find a far more receptive audience that could help it quickly reach scale and to make the connections between supply and demand — both of which already exist in abundance.

[ensia.com](#), 26 May 2020

<https://www.ensia.com>

### In a flash! Imagine downloading 1,000 HD movies in a split second, researchers in Australia have done it

2020-5-23

**Melbourne:** Scientists have achieved the world’s fastest internet data speed, which is enough to download 1000 HD movies in a split second, using a single optical chip, an advance that can help scale up the capacity of network connections across the world.

According to the study, published in the journal *Nature Communications*, the new innovation could fast-track telecommunications capacity of countries struggling with demand on internet infrastructure.

The researchers, including Bill Corcoran from Monash University in Australia, recorded a data speed of 44.2 Terabits per second (Tbps) from a single light source.

**The researchers, including Bill Corcoran from Monash University in Australia, recorded a data speed of 44.2 Terabits per second (Tbps) from a single light source.**

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This speed, the scientists said, was achieved by attaching their new device to existing fibre-optic technology, like the one used in broadband internet network.

“Initially, these would be attractive for ultra-high speed communications between data centres,” Arnan Mitchell, a co-author of the study from RMIT University in Australia, said in a statement.

They tested the transmission on 76.6 kilometres of optical fibres between RMIT’s Melbourne City Campus and Monash University’s Clayton Campus.

The fibre loop, according to the scientists, is part of the Australian Lightwave Infrastructure Research Testbed (ALIRT) established with investment from the Australian Research Council.

In the study, the researchers used their new device which replaces 80 lasers with one single piece of equipment known as a micro-comb, which is smaller and lighter than existing telecommunications hardware.

They explained that it acts like a rainbow made up of hundreds of high quality invisible, infrared lasers from a single chip.

Each of these lasers, the study noted, has the capacity to be used as a separate communications channel.

The scientists placed the micro-comb onto ALIRT’s optical fibres and sent maximum data down each channel, simulating peak internet usage, across 4 TeraHertz (THz) of bandwidth.

While this micro-comb has been used within a lab-setting, they said this is the first time it is used in a field trial.

With an unprecedented number of people using the internet for remote work, socialising, and streaming during coronavirus lockdowns, the researchers said the trial reflected the normal demand for internet infrastructure in a few years’ time.

“It’s really showing us that we need to be able to scale the capacity of our internet connections,” Corcoran said.

Based on the results, he believes that the fibres already part of internet infrastructure in the ground may be the backbone of communications networks now and into the future.

“And it’s not just Netflix we’re talking about here—it’s the broader scale of what we use our communication networks for,” he added.

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Corcoran said the data can be used for self-driving cars and future transportation, and it can help the medicine, education, finance and e-commerce industries, as well.

David Moss, Director of the Optical Sciences Centre at Swinburne University, said micro-comb chips have become an enormously important field of research in the ten years since he co-invented them.

According to Moss, micro-combs offer enormous promise for us to meet the world's insatiable demand for bandwidth.

"This work demonstrates the capability of optical micro-combs to perform in demanding and practical optical communications networks," the scientists wrote in the study.

asianage.com, 23 May 2020

<https://www.asianage.com>

### Researchers develop microalgae-based polyols for polyurethane polymers

2020-05-20

UC San Diego researchers develop methods for producing microalgae-based polyols for polyurethane polymers. The polymers can then be used to make polyurethane foams.

#### Converting Microalgae Oils into Azelaic Acid

The team chose to work with oil from the green microalgae *Nannochloropsis salina*, a common source of omega-3 fatty acids that are sold as dietary supplements. The leftover oils, more than 70-percent, are typically either thrown away or burned, but the UC San Diego researchers found a better use for them. They developed a process to purify and convert this waste stream into azelaic acid, a building block for flexible polyurethanes. They also converted the co-product heptanoic acid into food flavoring and fragrance.

"We showed that we could take waste products from algae-based omega-3 oil production and convert those into valuable and renewable polyurethane foams. These have all kinds of commercial applications, from flip-flops and running shoe soles, to mattresses and yoga mats," said Michael Burkart.

To start the work, the research team first found a scalable, cost-effective pathway to improve the purity of algae oil using simple physical methods along with saponification. This is a process by which oils react with sodium or potassium hydroxide to produce glycerol and a fatty acid salt, or soap.

**They developed a process to purify and convert this waste stream into azelaic acid, a building block for flexible polyurethanes.**

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In addition to the fatty acids, the team identified multiple contaminants in the waste oil. Microalgae contain a variety of metabolic components that are insoluble in water but freely soluble in the algae oil when extracted. The presence of these pigments inhibits downstream reaction efficiency, therefore their removal is a key process in the production of renewable chemicals from algae oil.

#### Scalable Process Can be Performed on Multiple Algal Species Oils

According to the scientists, their scalable process can be performed on oils from multiple algal species, to produce valuable monomers—molecules that take part in a chain reaction to form polymers—for a highly sustainable source of bio-based plastics. The study included an exploration of the economic value of the team's methodology.

Researchers chose the *N. salina* as a strain for growing algae in large scale because of its established high production of eicosapentaenoic acid (EPA), a valuable omega-3 oil, and the ability of scientists to grow the strain for high biomass content.

"We are already working with major shoe companies to turn these into commercial products that people will want to buy. We are finding that consumers are concerned about all of the petroleum-based plastic waste we are generating as a society, and our team is rapidly developing solutions for future products," added Burkart

polymer-additives.specialchem.com, 20 May 2020

<https://www.polymer-additives.specialchem.com>

### Australian scientists 'drastically improve' new solar cell technology

2020-05-22

Australian researchers have found ways to improve the durability of new solar technology that could rival or complement traditional silicon cells, bringing its mass production a step closer to reality.

Conventional solar cells used on roofs and elsewhere took four decades to pass efficiency rates of 25 per cent, a milestone new so-called perovskite cells have reached in about a quarter of the time while using low-cost materials. The stability of the new technology is yet to be assured.

Perovskite cells can be 500 times thinner than silicon ones and potentially much more flexible, meaning they could be used to coat everything from buildings to cars and drones. So far its commercial application has been limited because they are less durable to weather.

**Perovskite cells can be 500 times thinner than silicon ones and potentially much more flexible, meaning they could be used to coat everything from buildings to cars and drones.**

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Research by a team led by Anita Ho-Baillie, now at the University of Sydney, and Lei Shi from the University of NSW, has shown how cheap but high-performance polymer coatings used in double glazing can improve the durability of the cells so they can pass three key international standards for heat and humidity.

Add to shortlist

“We were pleasantly surprised,” Professor Ho-Baillie said. “We have shown that we can drastically improve their thermal stability.”

Scientists confirmed the results - published in the *Science* journal on Friday - using a type of mass spectrometry for the first time to show the cells were not decomposing under the stress tests.

“Our work is the first report on perovskite solar cells exceeding the requirement of the critical international electrotechnical commission test for heat and humidity by using a simple low-cost encapsulation technique,” Dr Shi said.

Professor Ho-Baillie stressed the cells need to prove their durability against light and heat, but added that many teams around the world were working to realise perovskite’s “very exciting” future.

Since perovskite cells are good at converting short-wave radiation into electrons while silicon excels at longer wave lengths, the two could be stacked, lifting efficiency rates above 29 per cent, Professor Ho-Baillie said.

The research was funded by the Australian Renewable Energy Agency and the Australian Research Council.

As reported earlier this month by the *Herald*, UNSW is preparing for a significant reduction in renewable energy research as federal funding for the agency is due to run out by 2022 and is starting to turn away prospective PhD students.

The government’s announcement this week of a “technology road map” towards a lower carbon economy did not clarify whether the agency’s solar research would be extended.

smh.com.au, 22 May 2020

<https://www.smh.com.au>

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**For the first time, renewable energy is expected to surpass coal in the U.S.**

2020-05-15

As one of the **biggest contributors** to the globe’s greenhouse gas emissions, the United States has never prioritized renewable energy over fossil fuels and coal. However, as a result of the coronavirus pandemic (and decreasing costs of renewable energy processes and recent climate change efforts), the U.S. is projected to become more reliant on renewable energy than coal for the first time ever.

One **New York Times article** breaks this change down. New **government projections show** a transformation in energy reliance driven by many factors, including the coronavirus and recent climate change efforts. The recent change to a priority of renewable energy is quite the feat for the U.S.—especially given it is one of the biggest coal countries in the world and, ten years ago, coal was so dominant that it **provided nearly half** the nation’s electricity.

Like most environmental discussions, there are a number of reasons for this shift. Of course, the coronavirus has **shut down the operation of many U.S. coal plants**, but since 2010, many coal plants have retired from economic hardships.

However, renewable energy is both a survivor of the coronavirus pandemic (economically) and an increasingly affordable industry. The cost of building large wind farms has declined **over 40 percent** in the last 10 years, while solar costs have **dropped more than 80 percent**. The price of natural gas—a cleaner-burning alternative to coal—has **fallen to historic lows** as a result to the fracking boom.

eponline.com, 15 May 2020

<https://www.eponline.com>

**Are nanomaterials getting under your skin?**

2020-05-20

**Helsinki, 20 May 2020** – The study, commissioned by the EU Observatory for Nanomaterials (EUON), found that the lack of standardised, validated methods and the use of varying testing protocols makes it difficult to compare results and evaluate whether nanomaterials can penetrate the skin.

**Of course, the coronavirus has shut down the operation of many U.S. coal plants, but since 2010, many coal plants have retired from economic hardships.**

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Based on the findings, nanomaterials rarely absorb through intact skin, except for silver that is likely to partly penetrate in ionic form. Silver is used for its anti-bacterial properties in textiles and can be found in other consumer products such as pharmaceuticals and cosmetics.

Some of the analysed studies suggest that absorption through damaged skin is higher than through intact skin.

A key recommendation for any new studies that aim to provide proof of absorption through the skin is to perform them using tests performed on tissue in external environments with minimal alterations to natural conditions (ex vivo), comparable to OECD Test Guideline 428, with human or porcine skin. Rodent skin should not be used due to differences in skin characteristics between rodents and humans.

The study covered experimental data including tests performed inside the bodies of living organisms (in vivo) and ex vivo studies. It looked at factors associated with test methodology that can affect absorption through the skin, for example: exposure conditions, different experimental set-ups, and methods. The effects of the characteristics of nanomaterials on skin absorption, including particle size and surface charge, were also analysed.

In addition to compiling relevant studies, the study looked at test guidelines and whether the results are available in a structured way, for example, following OECD harmonised templates.

The study was carried out for the EUON by RPA consortium of Triskelion and RIVM.

### Background

Many products we use in our daily lives come into contact with our skin. Some, including cosmetics such as sunscreens, and textiles, use nanotechnology to improve their quality. This means our skin can also come into contact with manufactured nanomaterials.

This study looks at existing research to make recommendations for generating comparable and high-quality data to enable authorities to better regulate nanomaterials and companies to ensure their safe use.

The EUON aims to increase the transparency of information available to the public on the safety and markets of nanomaterials in the EU. A key aim of the observatory is to create a one-stop shop for information, where EU citizens and stakeholders including NGOs, industry, and regulators can

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find accessible and relevant safety information on nanomaterials on the EU market.

The EUON uses a part of its funding to carry out studies on different aspects related to the safety and uses of nanomaterials in the EU.

[euon.echa.europa.eu](https://euon.echa.europa.eu), 20 May 2020

<https://www.euon.echa.europa.eu>

**Some studies raise concerns about sunscreen chemicals. But if you dig deeper, evidence is still lacking, experts say.**

2020-05-17

It is part of a daily routine for some, and for others, a routine source of doubt and uncertainty: to wear sunscreen or not?

Recent research has deepened the confusion. In a clinical trial published this year, researchers from the Food and Drug Administration reported that six common chemical ingredients in sunscreens permeate the skin and enter the bloodstream in amounts high enough to require extra safety testing by the FDA. Levels of the chemicals, which included oxybenzone and avobenzone, increased with each subsequent day of use.

It can feel like a lose-lose scenario: If you put sunscreen on, you risk damage from chemical ingredients. If you don't, you risk UV damage from the sun.

Experts say there is still no evidence that chemical sunscreens cause harm, especially if used on limited areas that are most exposed to the sun. There are other ways of protecting yourself from UV rays in addition to sunscreen. And other sunscreen options exist: Studies show that mineral alternatives, including zinc dioxide and titanium dioxide, are both safe and effective.

"There's really no reason to forgo sunscreen when we have known tested safe alternatives," says Kanade Shinkai, a dermatologist at the University of California at San Francisco. Despite what can seem like alarming research, she adds, chemical versions are not necessarily dangerous. "The systemic absorption of chemical sunscreen does not necessarily mean that it's unsafe or unhealthy. And avoiding the risks of UV exposure is still a very important health aim."

**It can feel like a lose-lose scenario: If you put sunscreen on, you risk damage from chemical ingredients. If you don't, you risk UV damage from the sun.**

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Sunscreen has a decades-long history that gave it a pass onto pharmacy shelves, Shinkai says. Invented before the FDA developed standards for testing over-the-counter products for safety and effectiveness, sunscreen was grandfathered in for sale before its ingredients had been thoroughly studied.

Over time, plenty of evidence has accumulated to show that UV radiation from the sun triggers skin cancers, including melanoma, and that sunscreen helps mitigate those risks.

In one long-running study of more than 1,600 people that began in 1992, Australian researchers randomized people to either wear sunscreen or do what they normally do. After more than a decade of follow-up, results showed that, compared with the group that didn't get instructions to slather it on, the sunscreen group developed far fewer cases of skin cancer, says Henry Lim, a dermatologist at the Henry Ford Medical Center in Detroit.

In another study published in 2012, one of the same researchers and colleagues estimated that increasing sunscreen use could lead to between 231,000 and 797,000 fewer melanomas for people with white skin in the United States by 2031.

But for decades, evidence has also been accumulating to suggest that the ingredients in sunscreen can get through our skin and into our bodies.

In a 1997 study, researchers instructed nine healthy people to apply sunscreen with a sun protection factor of at least 15 on their forearms, using the amount they would normally use. Twelve hours later, they washed the sunscreen off with soap and water. Urine samples taken before and after application showed that between 1 and 2 percent of the applied amount of oxybenzone seeped through the skin.

Then in 2008, researchers from the Centers for Disease Control and Prevention analyzed more than 2,500 urine samples collected as part of the long-running National Health and Nutrition Examination Survey. They found the sunscreen ingredient benzophenone-3 in nearly 97 percent of samples. The study couldn't show that sunscreen was the source of the chemical in people's bodies, Shinkai says: The same chemicals are also used on commercial products, such as outdoor lawn furniture. Still, the results were suggestive.

Testing data from the FDA finally started to come out in 2019, two decades after the agency announced its plans to systematically investigate the

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safety of sunscreen. The study included 24 people who applied sunscreen four times a day for four days, covering 75 percent of their bodies with each application. Participants were randomized into four groups, who received different combinations of four active ingredients (avobenzone, oxybenzone, octocrylene, and ecamsule) in creams, lotions or sprays.

Results drew plenty of attention: analyses of blood plasma showed, for the first time, concentrations of all four ingredients that exceeded levels at which FDA guidelines require more safety testing.

"It was the first study to really demonstrate that four really common ingredients that are found in the top-selling sunscreens are all absorbed into the bloodstream, and they do so at levels exceeding that safety threshold set by the FDA," Shinkai says.

The FDA's follow-up study in 2020 duplicated the results for three of the same ingredients and three others in 48 people. It also found levels exceeding the threshold after a single application.

Shinkai emphasized that the studies don't show that sunscreen causes harm, and that more research is needed. "We have no idea whether there is actually any negative health impact," she says. "We need the data."

One reason not to freak out yet about the new findings is that the amount of sunscreen that participants were instructed to use does not mimic real-world conditions, Lim says.

Multiple studies suggest that, when left to their own whims, people use 80 percent less sunscreen than the 2 milligrams per centimeter of skin enforced in the study. Study participants also covered most of their bodies with sunscreen multiple times a day, whereas typical use is far less extensive.

"Most of us only do that for the three days a year we go to Florida," Shinkai says.

Even if sunscreen chemicals do get into the bloodstream, it is not clear that they cause harm there, either.

Animal studies have raised concerns about endocrine disruption and reproductive issues. But animals are not people, Lim says. And despite decades of sunscreen use, there has been no population-wide signal that rates of infertility, birth defects or other health problems are higher in people who use more sunscreen or in places where people apply more of it.

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So far, safety research has included only healthy adults, leaving a dearth of information about potential risks to pregnant women and children. Because children's bodies have a relatively larger surface area compared with adults, absorption is theoretically higher, Kanade says. Lim advises his pregnant patients to use mineral sunscreens, which have been studied extensively.

To stay safe from the sun, researchers also recommend looking beyond sunscreen to other strategies. Wear hats, sunglasses and clothing. Concentrate time outdoors during the hours of the day when the sun is not as intense — early in the morning or later in the afternoon. Sit in the shade. And take a vitamin D supplement to avoid inconsistent evidence about how much of the vitamin people manage to get from sun exposure.

"What I tell all my patients is that we do know that excessive sun exposure is not good for your skin, from wrinkling to skin cancer," Lim says.

Protecting yourself requires a multipronged approach, he adds.

washingtonpost.com, 17 May 2020

<https://www.washingtonpost.com>

### How security cameras are developing AI cameras to measure social distancing and mask compliance

2020-05-19

While the demand for thermal cameras with fever detection capabilities **has skyrocketed during the coronavirus pandemic**, video surveillance companies are hard at work on systems that could help stores and other businesses measure social distancing compliance and conduct crowd control.

According to **reporting from Fast Company**, at least three companies are developing ways to outfit traditional camera systems with artificial intelligence that would make it possible to alert employees when people are standing too close to each other -- closer than six feet apart -- or not wearing a required mask.

**People-counting cameras** have been on the market for years, particularly for retail businesses seeking to track how customers navigate their stores. But these systems, including one in the works at Motorola Solutions, would go a step further and identify social distancing behaviors so that shoppers could come back to a store when it was less crowded.

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"You already are hearing about things like 'Waze for occupancy and people movement,' as opposed to vehicle movements—not just self-reporting, but automated reporting on traffic information of people in different indoor locations and public areas," Mahesh Saptharishi, the CTO of Motorola Solutions, told Fast Company. "I think that's just going to be more common until people feel safe enough."

Hypothetically, these surveillance systems would also help managers and building planners figure out which parts of their space are more susceptible to social distancing issues and place more reminders in those areas. Motorola and tech company Camio are focusing mostly on offices and factories where managers are concerned about their employees working too closely to each other, but could expand into more public spaces as well.

securitytoday.com, 19 May 2020

<https://www.securitytoday.com>

**But these systems, including one in the works at Motorola Solutions, would go a step further and identify social distancing behaviors so that shoppers could come back to a store when it was less crowded.**

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**PFAS-free firefighting foams: Are they safer?**

2020-05-18

In the 1960s, researchers from the U.S. Navy Research Laboratory began testing a new class of firefighting foam that could rapidly extinguish fuel fires.

The foams, dubbed aqueous film-forming foam (AFFF), were a boon to firefighters. Special perfluorinated chemicals gave AFFF unique hydrophobic and surfactant properties, allowing it to rapidly seal over burning fuel and prevent reignition once a blaze had been extinguished. By the 1970s, AFFF was in use at most military bases, airports, refineries, and many civilian fire departments around the world.

Over the next several decades, AFFF was used to both fight actual fires and to train firefighters on practice fires. It often was left to soak into the ground after use. AFFF is still in use today.

Flash forward to 2020, and we now know that the same chemicals that give these firefighting foams their unique properties have become a major global source of drinking water contamination. These chemicals, called per- and polyfluoroalkyl substances (PFAS) have been detected in water supplies across the country—and in our bodies. In fact, the [Environmental Working Group estimates](#) that PFAS chemicals are detectable in all major U.S. water supplies. [CDC scientists have found](#) four PFAS chemicals in the blood of nearly all Americans tested, indicating «widespread exposure to these PFAS in the U.S. population.»

They're often called forever chemicals, "because there's no indication that they will biodegrade in the environment, as they are extremely stable and persistent with a potential for them to be permanently present and cycling around the environment," Ian Ross, a PFAS contamination expert for Arcadis, a Netherlands-based engineering and consulting firm, told EHN.

PFAS have been linked to a slew of health issues, including hormonal changes, decreased fertility, weakened immune system response and increased cancer risk.

Studies suggest that firefighters have higher levels of these chemicals in their bodies than the general public. A [study of female firefighters](#), published in the journal *Environmental Science & Technology* in February, found that those who used firefighting foam in the past year had higher concentrations of PFAS in their blood than those who had not.

**PFAS have been linked to a slew of health issues, including hormonal changes, decreased fertility, weakened immune system response and increased cancer risk.**

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In light of mounting liability risk, state and local bans on PFAS-containing products, and pressure from various groups over environmental and health concerns, many fire departments, municipalities, and private companies now are looking to switch to PFAS-free foams. The adoption of PFAS-free firefighting foams in the U.S. is relatively new. In 2018, Washington became the first state to ban PFAS-containing foams for most firefighting uses. Several other states have since followed with similar legislation.

Making sure these new foams actually are safer for the environment and health than the ones they replace is key to ensuring we don't end up in the same place 50 years from now—with widespread contamination from a new set of toxic chemicals—say environmental health experts.

There's promise on this front, with a number of states taking action to ban or phase out PFAS-containing foams and a new certification program helping fire departments and businesses identify safer foam products, but hurdles remain at the federal level.

**Avoiding regrettable substitutions**

"We have a history of substituting one hazardous chemical with another that may not be any better," Philippe Grandjean, an epidemiologist at the University of Southern Denmark and adjunct professor of environmental health at Harvard University, told EHN.

Take bisphenol A (BPA) for instance. BPA has been removed from baby bottles and other plastic products in the last decade over concerns that it could harm health by disrupting hormones. But experts now warn the chemicals that have replaced it, including BPS and BPF, share the same endocrine-disrupting properties as BPA, making them no safer.

Experts call this common practice "regrettable substitution," when one hazardous chemical is replaced by another just as harmful or potentially worse. This happens because federal regulators, for the most part, don't require chemical replacements to be proven safer before they're put into use.

Today formulations of products such as pesticides, flame-retardant containing furniture, non-stick pans, and nail polish, contain so-called regrettable substitutions.

Not all fires call for the use of foam. AFFF is used primarily to douse fuel fires—those fed by flammable liquids such as oil or gasoline. A municipal fire department may have more limited uses for firefighting foams—say

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at the site of a road traffic accident—than industries such as oil and gas refineries, aviation, and the military.

Perfluorinated chemicals have special properties—such as their ability to prevent fuel pick up in the foam—that are beneficial to efficient firefighting, Niall Ramsden, director at ENRg Consultants, LTD, a UK-based consulting firm working with the oil and aviation industries to transition to PFAS-free foams, told EHN.

“It’s been a challenge to find replacements that give the same performance,” he said.

PFAS-free foams have been available for about 20 years, but the capabilities of these early products weren’t great, David Plant, Global Product Manager for Firefighting Chemicals for National Foam, a North Carolina-based foam manufacturer that makes fluorine-free firefighting foams as well as PFAS-containing foams such as AFFF, told EHN.

As a result of legislation in the European Union over the past decade and more recently in the U.S., companies including National Foam have ramped up investment in the research and development of new PFAS-free foam formulations that achieve the same performance standards as AFFF while meeting new environmental regulations. National Foam continues to manufacture PFAS-containing products, including AFFF, though it’s added two PFAS-free foams to their arsenal.

“What we don’t want to do is go from something that’s being phased out to something that could be tomorrow’s problem,” said Plant.

Yet what’s actually in these new products remains unclear. Formulations are a company’s tightly guarded trade secrets. Though Ross said that many of the new chemistries are “based on naturally occurring surfactants and oils.” That poses a problem for buyers.

Products can claim to be cleaner, greener, safer, but how do buyers know that’s actually true and not just greenwashing or marketing spin?

“Over the last decade, I think a lot of people have lost faith in companies to give us useful, honest information that’s protecting the public good,” Shari Franjevic, GreenScreen Program Officer for Massachusetts-based Clean Production Action, told EHN.

Even if companies disclosed their formulations to customers, most customers would have no way to meaningfully vet the products.

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Fire departments can test whether or not a product works well to extinguish flames, but they have no practical way of differentiating the products that are safest for the environment and firefighter health.

“They’re not experts in toxicity,” Erika Schreder, science director for Seattle-based environmental advocacy group Toxic-Free Future, told EHN.

### A potential solution

One U.S. nonprofit is working with makers and buyers of PFAS-free firefighting foams to make that screening process smoother. In January, Clean Production Action launched the first eco-label certification program for PFAS-free firefighting foams. The program ensures that foams claiming to be PFAS-free are, in fact, free of these added chemicals, as well as thousands of other chemicals of high concern, such as alkylphenols, surfactants that are found in detergents, cleaners, and other products and that may disrupt the body’s hormone system and organohalogens, a large class of chemicals that can be used as preservatives and that bioaccumulate in the environment.

The eco-label certification program, called GreenScreen Certified Standard for Firefighting Foams, kicked off as a pilot program in Washington State. In 2018, Washington led the nation in passing laws to phase out the use of PFAS chemicals in firefighting foams as well as other products, including food packaging.

The ban on the sale of PFAS-containing foams is set to go into effect this July, but will initially exempt some major users, including chemical plants, oil facilities and airports. The program takes complex toxicological information, including how likely a chemical is to bioaccumulate in the environment, and distills it into an easy to understand certification score, explained Franjevic. And it does so in a way that keeps a product’s formulation confidential—something that’s really important to manufacturers.

GreenScreen isn’t new. The tool first launched in 2007 to help purchasers of chemicals complete a hazard assessment of individual chemicals. But most companies don’t buy chemicals, they buy products, Mark Rossi, executive director of Clean Production Action, told EHN.

So, in 2017, the non-profit launched the GreenScreen Certified program to give buyers in certain industries a simple way to assess the chemical safety of the products they purchase. There currently are GreenScreen Certified

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labels for products used in textiles manufacturing, building, and now firefighting foams.

GreenScreen's PFAS-free firefighting foam pilot started off small with four manufacturers and four certified products, including National Foam's flagship PFAS-free foam, Universal Green. Franjevic estimates there are between 30 and 35 manufacturers of PFAS-free foams worldwide, marketing more than 100 PFAS-free foams and said that a number of other companies have expressed interest in taking part in the program.

"The certification offers a third-party verification of claims that companies are making," which helps firefighting foam buyers understand whether those claims are true and meaningful, explained Rossi.

That independent accreditation is really important for Randy Kraus, Fire Chief for the Port of Seattle Fire Department at Sea-Tac International Airport.

"We want to make sure we don't do any additional harm to the environment or firefighters. As a purchaser, we want to make sure a product is tested by an independent third party. That gives us confidence," said Kraus in a February webinar hosted by Clean Production Action about the new eco-label.

### Challenges remain

While major international airports—including London Heathrow and Paris-Charles de Gaulle—already are successfully using PFAS-free firefighting foam, Sea-Tac and other U.S. airports will have to wait.

Several states, including Washington, Colorado, Minnesota, New Hampshire and New York all now have banned the use of PFAS chemicals in firefighting foams.

But airports in the United States are regulated by the Federal Aviation Administration (FAA), and the FAA currently requires all U.S. airports to use PFAS-based firefighting foams. While the FAA Reauthorization Act of 2018 requires the FAA to change their rules and stop mandating the use of these products by 2021, the FAA has chosen to conduct their own tests before allowing PFAS-free foams, which could take longer to complete.

PFAS-containing foams too, will stay in use at U.S. military bases for the near future. In December 2019, Congress directed the military to phase out PFAS in firefighting foams by 2024. Though, like the FAA, the military

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will first have to change performance specifications that require the use of PFAS chemicals.

As for GreenScreen Certified, Clean Production Action plans to expand the framework to evaluate safer PFAS-alternatives in additional products, such as food service ware.

Many food takeout products contain added PFAS to make them grease- and water-resistant, explained Rossi.

"There's a huge need for something like this as we move away from PFAS in many different products," he said.

ehn.org, 18 May 2020

<https://www.ehn.org>

### Taking NZ wine carbon neutral to lure younger buyers 2020-05-25

A glass of Marlborough sauvignon blanc is known the world over for its big blast of tropical fruit, but winemakers want to enhance their reputation by removing something - carbon.

Reducing emissions has become a key issue for producers and growers, with industry body New Zealand Winegrowers recently announcing its intention for the industry to be carbon neutral by 2050.

Making wine in an environmentally friendly way is nothing new, with a nationwide sustainability programme launched in the 1990s.

But the Zero Carbon Act, passed in November, has given the industry a renewed focus.

For Karen Titulaer, it is almost all she focuses on in her role as business sustainability and risk manager for Villa Maria, the country's biggest family-owned winemaker.

The industry itself had not become more carbon intensive over time, but it was more aware of the impact wine had on the planet, she said.

While there are many stages between a grape growing on a vine and people sipping a glass of wine, there were two key sources of carbon emissions - packaging and transport.

Titulaer said glass bottles had their positives and negatives.

**Reducing emissions has become a key issue for producers and growers, with industry body New Zealand Winegrowers recently announcing its intention for the industry to be carbon neutral by 2050.**

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While easily recyclable, bottles are far heavier than alternatives like cans or bag-in-box.

More niche options include a flax bottle made in France, and a cardboard wine bottle launched in 2014 by Californian company Ecologic.

Bars have also served kegged wine in an effort to drop both cost and waste.

Titulaer said glass bottles were better for the long-term quality of wine, but there were ways to cut their carbon footprint.

Only one company, O-I, produced glass bottles in New Zealand, so working with them to create a lighter bottle using more recycled material was key, she said.

Having bottles made with 10 per cent more recycled material meant a 5 per cent reduction in emissions per bottle due to lower heating and materials costs.

Other changes to Villa Maria's packaging products, including a different wrap for pallets and label paper, had helped reduce carbon emissions by 36 per cent in the past 10 years.

Lowering transport emissions was trickier, as most heavy equipment at vineyards required diesel fuel.

Villa Maria was interested in trialling electric tractors, but reducing fuel use went beyond the vineyard, Titulaer said.

Moving to electric forklifts in the warehouse reduced reliance on fossil fuels, as did shipping wine by rail or sea rather than road.

Villa Maria also planned to make its vineyards organic, which would reduce the use of sprays and result in more native plants going in the ground to suppress weeds.

But early signs indicated organic vines had increased resilience, which could be important in the face of climate change, Titulaer said.

Villa Maria was in the position to make large changes as a big company, but being small also came with advantages.

Alice Rule fits at the smaller end of the industry, producing just 4000 bottles of wine per year for her brand 3sixty2.

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She used plastic-free and fully recyclable packaging where possible, as well as low-weight glass.

Customers could also pay to offset emissions through CarbonClick when shopping online.

CarbonClick was similar to the offset option the likes of Air New Zealand used, but customers got a tracking number to see where their money was used.

CarbonClick also tracked what country a customer was from, then diverted money to offsetting projects, like tree planting, where customers lived.

All those measures, and others, were part of Rule's aim to have 3sixty2 be carbon neutral by 2023.

Being small meant she could quickly pivot towards new technology or practices, rather than having to roll out changes across a large company, she said.

"Being small means being agile."

But a key challenge for everyone, big and small, was data..

Some associated industries like packaging suppliers would not share their carbon footprints, leaving producers either having to guess or ignore it, she said.

Not having accurate data could result in companies spending too much money on offsetting.

"We see incredible companies trying to save the world, but then they go insolvent," Rule said.

"Sustainability is about the long-term economic viability, too."

Vineyard owners and wineries were also hampered by emissions accounting rules that currently do not allow carbon saved by grapevines or soil to be counted towards carbon neutrality.

That was despite vines being shown to sequester more carbon than some trees, she said.

Being able to become truly carbon neutral would be a massive selling point for New Zealand wine, which Rule said could be done faster than other countries.

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Being almost fully powered by renewable energy was a big plus, but the long term work of Sustainable Winegrowing New Zealand (SWNZ) was especially key, she said.

Established in 1997, SWNZ was one of the first wine industry programmes in the world aiming to improve environmental practices.

New Zealand Winegrowers sustainability manager Ed Massey said being able to prove your green credentials was a powerful marketing tool.

The overseas market for New Zealand wine grew on the back of the Baby Boomer generation, but that demographic would be buying less wine in the next 10 years.

Meanwhile, younger generations were generally more concerned about the green side of wine.

"If we are going to sustain our success, it's going to be younger people buying our wine," Massey said.

It was also important to take consumers on the ride with winemakers and grape growers towards reducing emissions.

Rule used the dairy industry as an example.

Farmers copped a lot of flack for their impact on the environment, despite the big strides they had made in recent years, yet people in cities still wanted milk for their barista-made coffee.

"We put pressure on producers, but the bottom line is that consumers play a role."

Using tools like CarbonClick was one way to make them feel accountable too, she said.

"My consumers are pleased to be on this journey and pleased to be seen to be helping."

For Titulaer, it was about finding what she calls the "sweet spot".

"For consumers, it's about enjoying a product they know is good for the environment and society, but also something they can enjoy.

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"This is a journey we are all moving along, and we all want to do the right thing."

stuff.co.nz, 25 May 2020

<https://www.stuff.co.nz>

### Plant-based "Meats" catch on in the pandemic

2020-05-22

The news for the American meat industry over the last month has not been good. Slaughterhouses closed as the coronavirus sickened and killed workers. Even after President Trump declared meat processing plants "critical infrastructure," hundreds of Wendy's restaurants ran out of hamburgers. As meat-processing plants have shut down, farmers have had to kill hundreds of thousands of pigs.

That hasn't slowed demand for meat. Sales from April 12 to May 9 were 28 percent higher than in the four weeks ending Jan. 18, before the first reported case of coronavirus in the United States, according to data from Nielsen.

But the meat industry's troubles may have provided a boost for plant-based meat substitutes, which had a jump of 35 percent in sales during the same period. (The increase just for uncooked products was more dramatic: 53 percent for the vegan products versus 34 percent for meat.)

To meet the demand, Impossible Foods has been hiring more workers, increasing pay and adding more shifts. Beyond Meat reported record sales in the first quarter of this year.

Those companies' new generation of plant-based alternatives — developed in laboratories, with long lists of unfamiliar ingredients — had been slowly catching on with consumers. But some say that reports of illness among meat-processing workers have made them even more curious.

#### A Growth Spurt for Plant-Based Meats

Before the pandemic, William Thomas, 19, usually bought ground beef and chicken on his weekly shopping trip near his home in Brookline, N.H. Since April, he has been buying plant-based meat instead. "I'd always been trying to block out a lot of what was going on behind the scenes of the meat industry, but I can't ignore it forever," he said.

**But the meat industry's troubles may have provided a boost for plant-based meat substitutes, which had a jump of 35 percent in sales during the same period.**

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Mr. Thomas, who is currently unemployed, is now eating a mostly vegetarian diet for the first time in his life.

“With the pandemic around, a lot of the industries, you know, not taking the proper precautions to make sure everyone is safe, I feel like that would probably also go in toward the products,” he said.

Some Americans were already looking to plant-based diets as a way to [combat climate change](#).

“I think it uses much less water to grow a bunch of peas than it does to grow a cow,” said Faizal Karmali, 45, an independent philanthropy consultant who lives in the Dumbo section of Brooklyn.

Mr. Karmali and his fiancée have been trying since December to eat a more plant-based diet. At the beginning of the coronavirus outbreak, he had a craving for meat. But then, he noticed higher meat prices and read reports of worker deaths.

“I just figured that the dynamics there were enough of a nudge not to bother creating more demand” for meat, he said.

Impossible Foods’ plant in Oakland, Calif., has not yet had any coronavirus cases, said the chief executive, Pat Brown. No cases have been reported at the North Carolina factory of Atlantic Natural Foods, which makes the Loma Linda line of plant-based foods, said Doug Hines, the company’s founder.

For years, plant-based meat alternatives, typically made of vegetables, legumes and grains, were widely considered of interest mostly to vegans and vegetarians. But in the past year, substitutes made with plant-based protein have shown up in fine-dining and [fast-food restaurants](#); even some large [meat companies](#) have started producing them. Although their creation involves [complex alchemy](#), some plant-based meats can cook up and taste [just like ground beef](#).

Even before the coronavirus, interest in plant-based meat was rising. From late December to early January, before the virus hit, sales of plant-based meat were up 30 percent over the same period a year earlier, according to the Nielsen data. Meat sales increased about 1 percent during that same period.

Now, for the first time, plant-based meats are often competitive in price with ground beef, and sometimes easier to find, as fears of meat shortages prompt bulk buying.

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During the pandemic, Monia Lauretti, 47, has been doing her grocery shopping online at [Instacart](#). She is a pescatarian, but her family eats meat. The website had put a cap on the amount of burgers she could buy — just one package per family. Then she saw a pop-up ad for the Beyond Burger.

“I wondered, what is this? I’ve never seen this before,” said Ms. Lauretti, a stay-at-home parent on the Upper West Side of Manhattan. “They taste like normal beef burgers, and they are delicious.” Her 16-year-old son, Alessandro Dal Bon, liked them, too. So she’ll buy them again.

Impossible Foods, which before the pandemic sold more of its products in restaurants than in grocery stores, has expanded its retail footprint. Mr. Brown said his products are now sold in more than 3,000 stores, up from fewer than 200 in January. Its work force of 653 full-time employees is up from 587 in January.

In the first quarter of the year, Beyond Meat, whose stock is publicly traded, reported net revenue of \$97.1 million, an increase of 141 percent over last year. Its products are now in 25,000 grocery stores nationwide, and the company recently expanded into China.

“We were saying that by 2030, Beyond Meat could have a \$1 billion in sales,” said Alexia Howard, the senior research analyst of U.S. food at [Bernstein](#), an equity research group. “Now, we’re saying by the end of 2020, which is only 18 months later.”

Beyond Meat will offer a value pack starting this summer, priced competitively with traditional meat products. “We did not anticipate doing this,” said Ethan Brown, the chief executive (who is not related to Pat Brown of Impossible Foods). “But when all of a sudden, you start to see wholesale prices move in the beef industry, we said, ‘We’ve got to do something now.’”

Although these companies have long criticized the meat industry, they are careful not to gloat over their successes.

“We’re not waving the flag saying, ‘This is great,’” said Mr. Brown, of Beyond Meat. “It’s a tragic situation. Sure, we want to reach more people throughout the period, but overall, it’s a tough thing.”

[nytimes.com](#), 22 May 2020

<https://www.nytimes.com>

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### Pandemic sheds lights on importance of biodiversity

2020-05-21

Though research indicates that the novel coronavirus originated in nonhuman animals, scientists remain unsure how exactly it emerged and was first transmitted between species. One theory is that it first appeared at a market where live and freshly killed animals are sold in the city of Wuhan, in China's Hubei province.

As increasingly dense human populations continue to encroach on the habitats of other animals, scientists fear that the risk of deadly viruses being transmitted between species will grow. The number of annual outbreaks of infectious diseases has tripled every year since 1980.

No infectious disease has spread so quickly across the globe as the novel coronavirus, and there is currently much debate about how to prevent rapid worldwide outbreaks of infectious diseases in the future. This pandemic has once again drawn attention to the disastrous decline in biodiversity, and this has been a particularly important subject for politicians and scientists this week. May 22 has been proclaimed International Day for Biological Diversity by the UN.

### Biodiversity meeting postponed

Originally scheduled to be held in China in the fall, this year's meeting of signatories to the UN Convention on Biological Diversity has been postponed because of the pandemic. Nonetheless, the signatory governments are still discussing ways on how to meet the global commitment agreed to in January to protect at least 30% of the planet's oceans and land by 2030 in order to minimize the decline in biodiversity. The United Nations has also now called for a ban on live animal markets such as the one in Wuhan where the novel coronavirus may have emerged.

German Environment Minister Svenja Schulze, a Social Democrat, has another priority. "China reacted immediately and closed the dangerous markets," she told DW after presenting a report on the state of nature in Germany. "What's important from a European point of view is that the wild animal trade, which is largely illegal, be suppressed. We have to act against the criminals. This is the job of the police and customs officers. We're working on it." Christoph Thies, the forests and climate campaigner for Greenpeace Germany, had a similar point of view. "We cannot expect people to stop eating meat from wild animals overnight," he told DW. "There are regions where it's an important part of people's food."

**The number of annual outbreaks of infectious diseases has tripled every year since 1980.**

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### 'What is needed'

Thies said he hoped that biodiversity would once again receive the attention that it deserves and that the environment and nature would be examined in the context of climate change. At the Earth Summit in Rio de Janeiro in 1992, where the Convention on Biological Diversity was signed, the subject was considered as important as desertification and climate change. In the following decades, however, climate change became the main talking point. The three topics are intricately interconnected, Thies said: "Restoring forests and other ecosystems can help to contribute to 20-30% of what is needed to meet goals regarding climate change."

"In many countries, in many governments, the people who deal with biodiversity and protecting nature often have little to do with people dealing with climate change," Thies said.

Germany only has about 10% of the number of partridges and lapwings that it had 25 years ago, according to a report published by the Environment Ministry in May. Globally, about 35% of invertebrate pollinators, such as bees and butterflies, face extinction, the United Nations reports.

"There has been some improvement in the beech forests, and with the birds, in cities, in the forests, but the situation regarding agricultural land is really critical" Schulze said. "What we now call insecticide is happening. We say that in our report. More has to be done about this."

Antje von Broock from Friends of the Earth Germany told DW that "the protection of insects calls for knowledge and funds" at the national level, but also by the European Union. "We are campaigning to make sure that farmers receive money so that they actually do something for nature and agriculture," she said.

So, if the European Union were to change its agricultural policies, fewer live and freshly killed nonhuman animals were sold at markets globally, and the illegal animal trade were stopped, real progress could be made during the coronavirus pandemic to slow the decline in biodiversity.

"It is becoming increasingly clear that the outbreak of infectious diseases is connected to the destruction of forests and other ecosystems," Thies said. "Apart from the other more traditional reasons for protecting the

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environment, restoring biodiversity and the forests, there is also that of protecting health and preventing outbreaks of dangerous diseases.”

dw.com, 21 May 2020

<https://www.dw.com>

### Traffic is way down because of lockdown, but air pollution? Not so much

2020-05-20

With traffic dramatically down in recent months, the United States is in the middle of an accidental experiment showing what happens to air pollution when millions of people stop driving.

The air is clearer. But the pollution declines aren't nearly as large as early indications suggested, according to an NPR analysis of six years of Environmental Protection Agency data.

In some cities, the amount of one pollutant, ozone, has barely decreased compared with levels over the past five years, despite traffic reductions of more than 40%. Ground-level ozone, or smog, occurs when the chemicals emitted by cars, trucks, factories and other sources react with sunlight and heat.

NPR analyzed more than half a million air pollution measurements reported to the EPA from more than 900 air monitoring sites around the country. We compared the median ozone levels detected this spring with levels found during the comparable period over the past five years.

Our analysis revealed that, in the vast majority of places, ozone pollution decreased by 15% or less, a clear indication that improving air quality will take much more than cleaning up tailpipes of passenger cars.

In cities such as Los Angeles, stubbornly poor air quality during the coronavirus lockdown underscored how vast fleets of trucks are a dominant source of pollution. In industrial cities like Houston, refineries and petrochemical plants spew considerable air pollution. And in Pittsburgh and across a swath of the eastern U.S., much of the air pollution still comes from burning coal.

Scientists say those cities, where air pollution often exceeds federal health standards, will likely have to change the way they generate power, manufacture goods and move those goods around if they hope to have healthy air.

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“I think it's a really important [question] to think about: What can we learn from decreases in traffic pollution?” says Jenna Krall, a statistician and air pollution expert at George Mason University. “It will give us more information about what these pollution mixtures could look like [with] fewer people driving.”

### Los Angeles — trucks overtake cars

Initially, the virtually nationwide lockdown appeared to have dramatically positive results. In early April, NASA published satellite images of pollution disappearing over New York City.

After California issued a stay-at-home order in mid-March, greater Los Angeles saw the longest stretch of clean air that had been documented in decades. In Los Angeles, the skies seemed to clear just as rarely seen images of nearly empty freeways began to make headlines. It was welcome news for an area with some of the highest levels of ozone in the country, often exceeding federal health standards.

Breathing polluted air for long periods of time can damage the lungs and make it more difficult to fight respiratory disease. Ozone pollution is especially detrimental to children and elderly people and those with asthma, emphysema and other respiratory illnesses. The COVID-19 pandemic adds another respiratory disease to that list.

But the cleaner air wasn't just about reduced traffic.

A series of rainstorms swept through Southern California in March, which helped remove pollutants from the air. But as the weather warmed up in late April and early May, the air quality worsened, even hitting the “very unhealthy” warning category from the EPA.

“There was a lot of pressure on us to come up with the answer that everyone wanted to hear, which is that the COVID-19 measures have cleaned the air in Southern California,” says Philip Fine, deputy executive officer at the South Coast Air Quality Management District, which regulates air quality in greater LA.

Overall, ozone levels were down only 14% in late March and April compared with the same period over the previous five years, according to NPR's analysis. The modest drop points to a fact air regulators have long emphasized: Cars are not the biggest air pollution problem in Los Angeles.

“I've read a lot of newspaper articles over the past couple weeks that have said if only we can have people telecommute one day a week across

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the entire basin, our air quality problems will be solved," says Fine. "And unfortunately, it's not that simple."

As passenger cars have gotten cleaner, they've become a relatively smaller source of pollution. Heavy-duty transportation, such as trucks and buses, now accounts for the largest source of nitrogen oxides, which form ozone, in the area. Major ports in Los Angeles and Long Beach handle more than 30% of the nation's shipping container traffic, requiring a vast network of ships, trucks and trains coming in and out of the region.

Emissions from those sources, combined with hot and stagnant weather, cause air pollution to hit dangerous levels during the summer, which puts the region out of compliance with federal air standards. Low-income communities are hit the hardest.

While activity at the region's ports has slowed with the pandemic, trucks have largely stayed on the roads to ensure that goods are arriving in stores. At the end of April, truck activity was down only about 8% across California, according to the American Transportation Research Institute.

In a strange wrinkle, the reduction of one pollutant can also make ozone slightly worse. Cars and trucks produce nitrogen oxides, also known as NOx. While that pollutant helps form ozone, under some conditions it can temporarily break down ozone molecules. So with less NOx being emitted recently, ozone hasn't been suppressed as much.

"Small reductions in NOx actually increase ozone," says Cesunica Ivey, assistant professor of chemical and environmental engineering at the University of California, Riverside. "So we're just going to have to be more aggressive with our sustainable transportation solutions."

Severe Los Angeles smog in the 1950s and '60s prompted California to ultimately pass some of the most aggressive air quality regulations in the country. The state still sets its own tailpipe emissions standards for cars, apart from the federal government. The Trump administration is now seeking to revoke California's legal authority to do so.

California also has an ambitious target for putting 5 million electric cars on the road by 2030. That could help lower emissions because instead of burning gasoline, those cars would run on electricity, largely generated by solar, wind and hydropower in the state.

Now California is crafting a similar policy for trucks. State regulators are expected to vote on rules in June that would require truck manufacturers to sell all-electric or fuel-cell trucks in the state — from delivery trucks all

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the way to tractor-trailers. The policy would begin in 2024, requiring that 5% to 9% of sales be electric, depending on the type of truck. By 2035, it would be up to 40% to 75% of sales.

Some truck manufacturers have pushed back against the proposal, saying the market for selling electric trucks hasn't developed yet. Supporters say higher sticker prices would be offset by fuel savings over time, and when paired with California's other efforts to reduce greenhouse gas emissions, could potentially save thousands of lives by improving the air.

"We don't need a pandemic to breathe cleaner air," says Yifang Zhu, professor at the Fielding School of Public Health at the University of California, Los Angeles. "There is a sustainable way for a society to achieve a cleaner world in the future. We need to do more than we're doing right now."

### Pittsburgh — coal on display

Less car traffic makes pollution from coal more obvious in the broad swath of Midwestern and Eastern states where the majority of coal-fired power plants are still operating. Compared to passenger cars, burning coal releases large amounts of air pollution, including nitrogen oxides and small particulate matter, or soot.

Nowhere is the role of coal in air pollution more evident than in Allegheny County, Pa., where Pittsburgh is located. The county is home to a major coking plant that uses coal to make the fuel for the blast furnaces in steel factories, as well as a coal-fired power plant. Both continued to operate during the lockdown along with other steel facilities clustered in and around the county.

Between March 15 and the end of April, NPR's analysis found ozone levels in the Pittsburgh area dropped about 9%, compared with 14% in Los Angeles. Across the coal-intensive Ohio River Valley, the analysis concluded that in major cities, ozone dropped only between 3% and 8%.

Scientists say that's not surprising because coal is the dirtiest of fossil fuels. "Unlike a lot of the eastern part of the United States, there's not much, if any, coal-fired power plant production in California," says Emily Elliott, a geochemist at the University of Pittsburgh who studies nitrogen oxides.

Pollution from burning coal also affects a larger area than vehicle emissions, which means modest air pollution reductions in East Coast states may partly be because of their location downwind of coal-fired facilities. "If you think about a power plant that has a tall smokestack, those

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emissions are going high aloft in the air and they're going to travel long, long distances compared to a vehicle tailpipe that's close to the ground," Elliott says.

### Houston — the petrochemical industry's role

Coal is not the only industry culprit for poor air. NPR's investigation found that residents of Houston did not breathe significantly cleaner air during the lockdown, despite a 40% reduction in local traffic.

Houston experienced an 11% decrease in ozone. Daily ozone levels in Houston were still high enough to trigger an air quality warning in the city in mid-April.

The Houston metro area is home to the largest concentration of petrochemical facilities in the country. Refineries and chemical plants are major emitters of not only nitrogen oxide, but sulfur dioxide, which also contributes to smog and haze.

NPR's analysis also found only modest decreases in Houston's soot pollution during the lockdown. The median amount of soot in the air decreased by just 13% in Houston compared with the previous five years, according to air monitoring sites that reported data between March 15 and the end of April. Air monitoring sites that reported comparable data in greater Los Angeles showed a 30% decrease. There was not adequate data to compare soot levels in Pittsburgh.

Chronic exposure to soot is associated with shorter life expectancies, lung cancer, diabetes and low birth weight and can exacerbate respiratory and cardiovascular illnesses.

Regulatory rollbacks could make industrial pollution more severe in the future. The Trump administration announced this spring that it will not strengthen limits on soot, despite an assessment published earlier this year by EPA scientists that found that a stronger standard would save lives.

### An accidental experiment

Scientists around the country say reduced car traffic offers them an unexpected opportunity to study how cars, trucks, factories and power plants contribute to air pollution and to test the assumptions that go into pollution models.

One such study is already underway at Texas A&M University, where atmospheric scientist Gunnar Schade examined preliminary air data for

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the city of Houston and found that levels of particulate matter increased slightly in at least one location in Houston during the lockdown.

"That was a somewhat surprising result, that particulate matter is not going down at all," he says. "We assume that car traffic does contribute to [small particulate pollution]. It has in the past."

Schade's analysis, which has not been peer reviewed and is still being updated as more data becomes available, also suggests that particulate pollution decreased more in residential parts of Houston than it did in industrial areas.

Schade says it's too soon to be sure whether that means the pollution came from the industrial sites — he needs more data.

Despite decades of research and a relatively robust set of satellites and ground-based air monitors, there are still sizable holes in our understanding of how different sources of air pollution contribute to overall air quality, according to Elena Craft, the director of climate and health at the Environmental Defense Fund in Texas.

The pandemic could help make scientific models of what are called emissions inventories more accurate. "If you take all the cars off the road and it doesn't put a dent in your emissions inventory, then probably cars are not making up a lot of that inventory," explains Craft. "But if, on the other hand, you take all the cars off the road and air quality is great, then you may tweak the models."

[npr.org](https://www.npr.org), 20 May 2020

<https://www.npr.org>

### Historic agreement gives monarch butterflies the 'right-of-way'

2020-05-20

The side of the road isn't usually thought of as ideal habitat. But for insects, such as butterflies and their caterpillars, the long expanses of land along roads and utility corridors add up to a considerable amount of home turf.

More than 45 transportation and energy companies, as well as dozens of private landowners, have agreed to create or maintain monarch butterfly (*Danaus plexippus*) habitat along "rights-of-way" corridors across the United States.

**Populations of both eastern monarchs and western monarchs have declined by more than 80% over the past decade and are nearing a tipping point for migratory collapse.**

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The U.S. Fish and Wildlife Service (USFWS) and the University of Illinois at Chicago (UIC) have signed a historic agreement that allows participant landholders to dedicate a percentage of their lands to monarch conservation management in exchange for regulatory flexibility on the rest of their enrolled lands.

Populations of both eastern monarchs and western monarchs have declined by more than 80% over the past decade and are nearing a tipping point for migratory collapse. In light of these declines, the USFWS is set to decide in December 2020 if the monarch butterfly will be classified as a federally endangered species under the Endangered Species Act.

Land managers and businesses expressed concerns that if they voluntarily created monarch habitat and the monarch was then listed as federally endangered species, the resulting regulations to protect monarchs could complicate their operations or subject them to additional permitting requirements.

"Some companies wanted to wait to see how the listing would play out," Iris Caldwell, a program manager at the Energy Resources Center at UIC, told Mongabay. "But if you are following what's happening with the butterflies you know we really can't wait. We need to be creating habitat on a variety of different landscapes, as much as we can."

This led Caldwell and her colleagues in the Rights-of-Way as Habitat Working Group (a group of 200 transportation, energy, government, and nonprofit organizations) to ask what kinds of tools existed to eliminate these regulatory uncertainties faced by landowners.

"How can you incentivize a regulated entity or a utility to do this voluntary proactive work," Caldwell asked, "and still give them kind of the flexibility and the certainty that they need and be able to, in fact, invest in that work without kind of a fear of repercussion?"

The group decided to make use of the USFWS Candidate Conservation Agreement (CCA) and Candidate Conservation Agreement with Assurances (CCAA). Both are formal, voluntary agreements between participant landowners and the USFWS aimed at conserving and protecting at-risk species.

In the CCAA, the USFWS provides assurance that the landowner participants will not be required to take additional conservation measures on their enrolled lands if the monarch butterfly later becomes listed as an endangered species.

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"So they can just kind of go about business as usual. And if they happen to accidentally kill monarchs in that process, they won't be subjected to the under the endangered species laws," Tara Cornelisse, a senior scientist at the Center for Biological Diversity, an organization who submitted comments on the agreement, told Mongabay. "So, in turn, what they're supposed to do is give a percentage of those enrolled lands over to conservation."

Some of the conservation actions available and recommended to the landholder participants are: adjusting the timing of mowing practices to avoid periods when the monarch larva will be present; moving away from broadcast herbicide spray to targeted herbicide applications; replanting after a construction project on their right-of-way; and using a native seed mix across their system that help promote beneficial plants.

"Some of these organizations manage hundreds of thousands of acres of land and implementing some of these actions across a system of that scale is no small feat," Caldwell said. "I think that kind of learning curve early on and rolling out and implementing some of these conservation measures at scale, may present a challenge for some."

This is why the role of UIC in coordinating efforts among all the partners who are involved will be really important, Caldwell says. UIC will serve as an intermediary between the landowner participants and the USFWS. The participants will be required to monitor certain data and self-report annually to UIC. UIC will follow up on any discrepancies or concerns and will then submit an annual report summarizing all of the overall work and efforts and any findings across the agreement to the Fish and Wildlife Service.

This is the largest and first nationwide CCAA in history, and Caldwell said she's hopeful that the data collected will lead to insights to inform best management and adaptive management practices for the conservation of monarchs.

"The elephant in the room," Cornelisse said, "is if this would preclude the listing of the species [as a federally endangered species]."

Monarchs have a much wider range of habitat and potential habitat than rights-of-way corridors. Up to 75%, of potential monarch habitat is on agricultural lands. Over the past few decades, urban sprawl, pesticide and herbicide-intensive agriculture, and climate change have contributed to the global declines of insects, including monarchs. An ESA listing would afford the species greater protection across their range.

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“The enrolled lands outside the adopted acres [areas managed for conservation] cannot be credited with benefiting monarchs,” the Center for Biological Diversity said in written public comments to the USFWS. “It is important that when the Service weighs the value of these lands in other contexts, such as the [Endangered Species Act]- listing decision, that not all enrolled lands be considered to be providing habitat for monarchs.”

“I think anybody who knows the science behind the monarch’s decline, and the extent of it would say, yes, this [agreement] could provide some benefits, but it cannot preclude the listing of the species,” Cornelisse said.

The USFWS anticipates that between 2 million and 26 million acres (809,000 to 10.5 million hectares) of land may be enrolled in the CCAA and CCA agreements, but the percentage of the enrolled land that will be managed for conservation is still to be determined.

“What is striking to me is so often we just don’t think of these [rights-of-way] as conservation landscapes,” Caldwell said. “Oftentimes, we don’t think of them at all. We’re just driving past thousands of miles of roadsides and utility corridors. And so, the whole idea of being able to maximize these landscapes to create habitat for species that really need it, I think, is really exciting.”

news.mongabay.com, 20 May 2020

<https://www.news.mongabay.com>

### You have five appetites, not one, and they are the key to your health

2020-05-20

STELLA lived on the outskirts of Cape Town, South Africa. It was a beautiful, rural setting just below Table Mountain, surrounded by vineyards, trees, wild fynbos heathland and scattered settlements.

In 2010, Caley Johnson, a graduate student of anthropology at City University of New York, arrived to study Stella. For 30 consecutive days she followed her, watching and recording exactly what, and how much, she ate.

Stella’s diet was extremely diverse: almost 90 different foodstuffs over that time. On the surface, she didn’t appear particularly discerning. And indeed, the ratio of fats to carbohydrates in her diet varied widely from day to day.

**When she looked at the ratio of combined daily calories from carbs and fats to calories from protein, she always got close to 4:1.**

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But when Johnson crunched the numbers, something interesting popped out. When she looked at the ratio of combined daily calories from carbs and fats to calories from protein, she always got close to 4:1. This happened every day, regardless of what Stella ate. Even more interestingly, this ratio was very similar to what is considered nutritionally ideal for a female of Stella’s size. Far from being indiscriminate, Stella was a meticulously healthy eater.

How did she calibrate her diet so precisely? Doing so is difficult, and even professional dieticians have to use computer programs to do it. But Stella didn’t have access to a program because she was a wild Cape baboon.

The Stella study is one of many that we have been involved with over the course of our 30-year scientific collaboration. As a result, we think we have discovered something profoundly important about human nutrition, which changes how we understand appetite, explains the obesity epidemic – and suggests a way of solving it.

Our journey began in 1991, when we were colleagues at the University of Oxford. We set out to answer two questions. First, how do animals choose what to eat? And second, what happens if they fail to follow a healthy diet? To find out, we designed a huge experiment using the most voracious and indiscriminate eaters we could think of: locusts.

We put 200 young locusts in individual plastic boxes and prepared 25 different foods containing various proportions of protein and carbohydrates, the main nutrients the insects eat. The foods ranged from high-protein/low-carb to high-carb/low-protein, and everything in between.

Each locust was fed just one of the 25 formulations, in unlimited quantities, until they reached adulthood and shed their skin. This took a minimum of nine days and up to three weeks. We meticulously recorded how much each locust consumed each day, plus their weight and how much fat and lean tissue they had put on.

Once all the locusts had reached adulthood or died, we worked out which diet was closest to ideal. For that, we identified the mixture of protein and carbs that allowed locusts to grow and survive best. This turned out to be approximately 300 milligrams of carbs and 210 milligrams of protein a day.

Then we looked at what the locusts had actually eaten. Obviously they were restricted by their diet, but what was striking was that all of them

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managed to get close to the ideal amount of protein, even if that meant missing the carbs target by miles.

The locusts that were given a low-protein diet, for example, hugely overate carbs, consuming more than double the target amount. And that came at a cost. They took much longer to reach adulthood and they got fat. Granted, it is hard to tell that a locust is fat because of its exoskeleton. But it is chubby on the inside, like an overweight knight wedged into a small suit of armour.

In contrast, the locusts on a high-protein diet ate too few carbs and were unhealthily lean. They were less likely to survive to adulthood, and those that did had too little body fat to survive in the wild.

This experiment documented for the first time the battle between two nutrients: protein and carbs. When the locusts' food didn't allow them to eat a balanced diet, they prioritised protein over carbs at great cost to growth and survival. In fact, we later realised that what we were seeing wasn't so much a competition between nutrients as between two appetites – one for protein, the other for carbs. Locusts had two separate appetites.

Up to that point, appetite had always been viewed as a single entity, an all-consuming drive that compels animals (including us) to eat our fill. This was the first hint that there was more to it.

The next question was whether the two appetites worked together to help the locusts achieve a balanced diet. So we performed another experiment where each locust had unlimited access to two different formulations differing in their protein and carb content. They were free to eat as much of the two foods as they liked. Regardless of which foods they had available, they combined them in precisely the right proportions to always eat an identical – and ideal – balance of protein and carbs.

This demonstrated that when locusts have a wide choice of foods, their two appetites collaborate so they consume an optimal diet. But when they are given imbalanced foods, as in our first experiment, the appetites for protein and carbohydrate compete, and protein wins. That suggested that, more so than carbohydrate, protein has to be carefully calibrated in the diet. We were later to learn why. If an animal has too little, it can't grow and reproduce, and too much protein speeds up ageing.

"We had found two appetites in locusts, but was the same true in humans?"

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This raised a much bigger question. We had discovered two appetites in locusts. Was the same true of other animals?

That was the purpose of the Stella study and many others that we have done. These have shown that appetite-driven nutrient balancing is common across the animal kingdom. It has been documented in life forms as diverse as slime moulds, cockroaches, beetles, spiders, cats, dogs, mink and non-human primates. Some turn out to have not two, but five appetites, three for the main macronutrients (protein, carbohydrates and fat) and two for specific micronutrients – sodium and calcium. Given a range of foods to eat, they will always precisely calibrate their intake.

This naturally got us thinking: do humans also have several appetites?

Answering this question wasn't going to be easy. Human nutrition science has always been bedevilled by the difficulty of getting an accurate record of what people eat. Most research relies on study subjects self-reporting. The trouble is, people forget.

Ideally, you want to treat your human subjects like locusts: keep them in isolation with only the food you provide, all weighed and measured. However, this doesn't get people banging down the doors to volunteer as participants.

Fortunately, we found a compromise. One of our students had access to an isolated chalet in the Swiss Alps, far from shops or restaurants. She recruited a group of 10 friends and family and took them there to spend a week as human locusts.

For the first two days, participants chose whatever they wanted to eat from a highly varied buffet. Everything they ate was weighed, and their intake of calories, protein, carbs and fat was recorded (caffeine, alcohol and chocolate weren't available).

On days three and four, the volunteers were divided into two groups. One group got a high-protein buffet, the other a low-protein, high-carb and high-fat buffet. For the final two days, they returned to the original diet.

In phase 1 of the experiment, our human locusts reliably got about 18 per cent of their calories from protein, in keeping with studies that show people typically need 15 to 20 per cent.

In phase 2, everyone maintained their absolute protein intake. But to do so, those on the low-protein diet had to eat 35 per cent more total calories, while those assigned the high-protein diet ate 38 per cent fewer calories.

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Our volunteers responded like locusts, with their appetite for protein dominating, and determining the total consumption of food.

### Your five appetites

We later did two bigger and more sophisticated versions of the chalet experiment, in Sydney and Jamaica, and found essentially the same thing: people on a low-protein diet consume more calories.

The explanation for this is that humans also have more than one appetite. In fact, we have the five that our earlier research found in some other organisms: protein, carbs, fats, sodium and calcium. It is a mistake to think of appetite as a single, powerful drive to eat. We need separate appetites to keep track of various nutrients, and hence to construct a balanced diet.

Those five have been singled out by evolution for good reasons. One is that there is a limit to how complex biological systems can get and still operate efficiently. We couldn't have specific appetites for dozens of nutrients. Another is that these nutrients are needed in very specific quantities. Third, some components, like sodium, were often rare in our ancestral environments and we needed dedicated machinery to seek them out, for example in mineral deposits.

What about vitamins and the other essential minerals? We probably didn't evolve specific appetites for them because our natural diets are rich in these nutrients, and by eating the right amounts of the big five, we automatically get enough of the rest.

As a result of our discoveries on the ways in which nutrient appetites interact – the dance of the appetites, as it were – we were confident in putting forward another hypothesis: in a food environment that is protein-poor but energy-rich, people will overeat carbs and fats as they strive to reach their protein target.

If true, the implications would be huge. It may come as a surprise, but we do actually live in a protein-dilute, energy-rich food environment. According to the UN's Food and Agriculture Organization, between 1961 and 2000, the proportion of protein in the average US diet fell from 14 per cent to 12.5 per cent, with the balance made up of fats and carbs. Given that shift, the only way people in the US could have maintained their target protein consumption was to increase total calorie intake by 13 per cent – more than enough to create an obesity epidemic.

Intriguingly, in our experiments with people, we found that most of the extra calories eaten by those on a low-protein diet came from savoury

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snacks, especially those that tasted of umami, the signature flavour of protein. Protein-deprived subjects were craving things that tasted like protein, even though they were made of carbs. Our food environment is awash with such umami-flavoured carbs and fats, which we call "protein decoys": crisps, instant noodles, crackers and so on.

These are also known as ultra-processed foods, which we now see as the main cause of the obesity epidemic. We are hardly the first to make that claim, but our research suggests we were looking at the problem of overconsumption the wrong way. It has less to do with these foods being full of fat and carbs than with them being depleted in protein.

Ultra-processed foods are industrial creations designed to be irresistible. They include such common fare as pizzas, crisps, breakfast cereals, sweets, bread, cakes, mayonnaise, ketchup and ice cream. More than half of the typical US and UK diet is made up of ultra-processed foods, and some people eat them almost to the exclusion of everything else.

The thing about ultra-processed foods is that they tend to be low in protein – which is expensive – and high in cheap carbs and fats. It is these foods that have largely been responsible for the dilution of protein in Western diets since the 1960s. And the more ultra-processed foods people eat, the more calories they need to consume to get the target intake of protein, with disastrous consequences.

Ultra-processed foods make us fat, but not because we have strong appetites for the fats and carbs they contain, as is often thought to be the case. Rather, it is because our appetite for protein is stronger than our ability to limit fat and carb intake. So, when protein is diluted by fats and carbs, our appetite for it overwhelms the mechanisms that normally tell us to stop eating fats and carbs.

Ultra-processed foods also contain very little fibre, which is filling and so puts a brake on appetite. Their frequent flavouring with umami, which our protein appetite craves, only makes matters worse. As a result, we eat way more than we should.

This realisation set us up to tackle the biggest challenge of all. Can this new view of appetite help us to fix our problems? The answer is yes. Here is how to take charge of your food environment and help your appetites work for rather than against you.

### How much protein?

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The initial step is to calculate your protein target. First, look up the daily energy requirement for your age, sex and level of activity. You can do this with something called the Harris Benedict equation calculator, available on [numerous websites](#).

Next, work out the portion of those calories that should come from protein by multiplying it by roughly 0.15 (that is, 15 per cent of energy from protein; this multiplier varies depending on age: 18 to 30-year-olds require 18 per cent (0.18), people in their 30s need 17 per cent and those over 65 should get 20 per cent). Then divide the resulting number by 4 to get the number of grams of protein per day you should eat (a gram of protein contains 4 kilocalories of energy).

Finally, work out how to obtain that from protein-rich foods such as meat, fish, eggs, dairy, pulses, nuts and seeds. This is slightly complex, but the protein content of all these foods is [available online](#) and on food labels.

Everything else flows from this. It will satisfy your protein appetite and automatically ensure that you don't overeat carbs and fats. In fact, you don't need to keep track of these at all, as your protein appetite will manage them for you. Just make sure you supplement the high-protein foods with mostly wholefoods, mainly plant-based, which will also supply the fibre you need.

Most important, avoid ultra-processed foods. Keep them out of the house. You will eat them if they are there. They are designed to be irresistible.

If you follow these steps, the rest should be easy. All you have to do is listen to your appetites – they will guide you towards a healthy and satisfying diet. That is what they evolved for: to work for you, not for processed food companies.

[newscientist.com](#), 20 May 2020

<https://www.newscientist.com>

### Hungry bumble bees make planets flower early by cutting holes in their leaves

2020-05-21

When bumble bee queens emerge from hibernation, they need to gather pollen and nectar to start their new colonies. If they wake up too soon, there may not be enough flowers in bloom. Now, researchers have discovered the bees have a way to order some fast food: They nibble holes

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in leaves, spurring plants to blossom weeks ahead of schedule. Many questions remain about the details of this strategy and how it evolved.

"It's certainly surprising," says Lars Chittka, a behavioral ecologist at the Queen Mary University of London, who was not involved. "We're only at the beginning of exploring this phenomenon."

Researchers at ETH Zürich chanced upon the discovery when they noticed curious bite marks on leaves while studying how bees respond to plant odors. They had added bumble bees to a research greenhouse and observed them cutting holes in the shape of half-moons. What was going on? At first, the researchers thought the insects might be feeding on fluid from the leaves, but the bees didn't stay long enough to get much. Nor did they appear to be taking any part of the leaves back to their colonies.

A key observation—that bumble bees from colonies with less food were more avidly damaging the leaves—suggested another goal. The researchers wondered whether the damage triggered the plants to flower sooner, providing pollen to the hungry pollinators. After all, some plants speed up their flowering when they are stressed by disease or drought because these threats provide an incentive to reproduce sooner. But no one had ever shown that a pollinator can stimulate flowering. "I thought it was a long shot," recalls Mark Mescher, an evolutionary biologist at ETH Zürich who co-led the research.

The researchers set up a greenhouse experiment with black mustard (*Brassica nigra*), a crop they had been studying. Ten plants were put in mesh bags with bumble bees that hadn't eaten any pollen for 3 days; they proceeded to nibble five to 10 holes in each plant. On average, **those plants flowered after 17 days**; undamaged plants that had not been exposed to bumble bees took an average of 33 days, the researchers report today in *Science*. In a similar experiment, tomato plants sped up their flowering by 30 days. "The magnitude of the effects is huge," Mescher says.

Hunger seems to be driving the bees: Another lab experiment showed that pollen-deprived bumble bees cut about four times as many holes as bumble bees that were fully fed. When the researchers put potted plants and a colony of bees on a roof at the ETH Zürich campus in early spring, before flowers were blooming, the bumble bees cut holes in the leaves. But as spring progressed, making more pollen available, the bees made fewer new holes. The researchers also noticed two wild species—red-tailed and white-tailed bumble bees—puncturing leaves, suggesting the

**Now, researchers have discovered the bees have a way to order some fast food: They nibble holes in leaves, spurring plants to blossom weeks ahead of schedule.**

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behavior may be widespread. “That was superexciting,” says Consuelo De Moraes, a chemical ecologist at ETH Zürich who co-led the research.

To find out whether the leaf damage alone triggers the plants to flower sooner, the researchers cut similar-size holes in leaves. Those plants flowered earlier than controls, but not as early as the ones bitten by bumble bees. An intriguing possibility, Chittka says, is that bee saliva might contain chemicals that prompt flowering—similar to chemicals in the saliva of plant-eating insects that prompt plant defense responses. The researchers hope to investigate that idea and to study chemical signaling inside the plants after they are bitten. “It would be a horticulturist’s dream if you could find some relatively low-cost biochemistry that would actually speed up flowering,” Chittka says.

But researchers are still puzzled about how such behavior, which may also benefit the plants by attracting early pollinators, evolved. It’s unlikely worker bees learn the trick: They live only 1 month and wouldn’t have enough time to see the results of their handiwork. If the behavior is instinctive, it’s hard to understand how it would have started, Chittka says. What initial benefit, for example, would damaging leaves have brought to the bees? Finally, to help their own colony (rather than distant ones), bees would need to keep their nibbling close to home. “For all of this to somehow have come about by evolutionary trial and error process,” Chittka says, “it’s surprising.”

sciencemag.org, 21 May 2020

<https://www.sciencemag.org>

### How smart city planning could slow future pandemics

2020-05-18

THE CITIES OF the world are sick. As the coronavirus pandemic continues, people living in metropolitan areas have been among the worst hit, unable to socially distance effectively and sometimes plagued with preexisting conditions that their cities helped create. Many municipalities weren’t built with highly transmissible infectious disease—or human health—in front of mind, and the toll of Covid-19 is making that oversight all too clear. “We’re on an urban planet. The global economy is living and dying by what happens in cities,” says Jason Corburn, who studies urban health at UC Berkeley. “We’ve got to pay attention.”

The Covid-19 pandemic is a chance to focus that attention on what can—and should—be changed, to reevaluate the way cities are built,

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maintained, and lived in. In the midst of this crisis, some cities have already begun doing so by closing roads to cars to create room for bicyclists and socially distanced pedestrians, or by building additional hospitals and homeless shelters. These stopgap, reactive steps are important and needed, but they will do little to slow or stave off this pandemic or help prevent the next one. To ward off the outbreaks of the future, it’s time to start thinking proactively, and long-term.

The best way to stop a pandemic is to never let it start. The majority of infectious diseases, including those responsible for pandemics, started out as animal pathogens. Generally speaking, these diseases don’t spring from wild animal populations to humans, either. They evolve from pathogens impacting domesticated animals: the avian flu from poultry; MERS likely from camels; swine flu, from, well, swine. There’s less consensus about the actual origin of the 1918 Spanish flu pandemic, but everyone agrees it was cross-species transmission, whether birds, swine, or horses were the culprit. But, according to James Spencer, who studies city planning at Clemson University and has conducted research on avian influenza, it’s not viruses that jump hosts in purely rural areas that go on to become pandemics. “If we want to prevent these things,” he says. “We have to do a better job of managing the extremely rapid changes going on where agriculture and urbanization are happening in the same space.”

The technical term for these areas is peri-urban, places on the cusp of integrating with a developed city while still keeping a foot in the agricultural world. They are especially common in rapidly urbanizing countries like China. When Spencer was studying avian influenza in Vietnam, he found it wasn’t the places that either totally lacked water and sewage systems, or the ones that had already developed them, that had seen the most destructive spread of the virus. It was the places beginning to construct their basic infrastructure. “My initial take on this is, if you can get those basic things right, and plan them out well, [spread of disease] can be minimized,” he says. “Not just the human infrastructure; the infrastructure to manage the hygiene of tens of thousands to millions of individual animals. It’s not the wet market that’s the problem, it’s that they don’t have any way to clean them.” Politically speaking, providing basic services to outlying communities seems to Spencer like an easy, attainable win: Nobody’s against toilets and running water.

That said, many of these peri-urban areas that serve as the origin points for pandemics are outside of the United States, and there’s plenty that America could focus on within its own borders. “Epidemics like smallpox and yellow fever led to major reforms in cities, like the fact that we have

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a water tap and indoor toilets and windows that give us air circulation," says Corburn. "That's what's celebrated as the urban sanitation movement, but it was as much about pushing the poor away from the wealthy, and providing to those who can pay first rather than [those who] need it most."

The legacy, and impetus, of those choices endures today. It's been compounded by centuries of racist housing policies and structural inequalities that have left many Americans trapped in poverty and illness, their health determined largely by their zip codes. The dense, polluted, and crowded conditions they live in, along with the preexisting health conditions created by those conditions, are why the black community and other racial minorities are so disproportionately impacted by Covid-19.

"It's hard to transform cities built along lines of segregation," says Richard Matthew, who studies urban planning, environmental change, and poverty at UC Irvine. "We manage the risk of rich parts of the city well, but we have left other parts of the city to fend for themselves."

The inequality—and resulting unhealthiness—of cities is a nuanced, layered, snarl of a problem thought by many to be intractable. "We can't have one-size-fits-all. We can't have a smart-city revolution that will lead to health," says Corburn. "We don't need a *solution*; we need to have a *process* that's much more open and inclusive and will center the people who have been marginalized."

In other words: Ask the communities what they actually want and need. Corburn recommends placing cities' highest budget, best designed, most beautiful new projects in the poorest, most neglected areas. Matthew thinks reducing manufactured density, including the number of people incarcerated, is key. Spencer wants cheap telemedicine stations throughout developing cities, available to anyone at low prices. "What's been alarming is watching homeless people being put up in hotels," says Billie Giles-Corti, who studies city planning and health at RMIT University in Melbourne, Australia. "What's going to happen at the end of the pandemic? There's going to be a real need for stimulus packages to include an investment in social housing." Giles-Corti also sees the Covid-19 pandemic as a chance to reshape cities to suit a healthier, walking-and-cycling lifestyle and sustainable energy to stave off chronic illness and pollution.

Any of these fixes would take time. "Of the 4 billion people living in cities, one out of three is living in a slum," Matthew says. "1.5 billion is an awful lot of people living in abject, deplorable conditions. That's not a number you can change quickly." It will also take money, and political will, but

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between stimulus packages and global public investment, Covid-19 may be the perfect time to start. Cities have already been rolling out policies that would have seemed radical at any other time, like moratoriums on evictions, to wide public approval. "If we can do it in an emergency, we can find a way to do it long-term," says Corburn. If the cost of inaction is another pandemic, prevention is worth the price.

wired.com, 18 May 2020

<https://www.wired.com>

### How Venus flytraps evolved their taste for meat

2020-05-14

How does a plant develop a taste for flesh? In the play *Little Shop of Horrors*, all it takes is a drop of human blood. But in real life, it takes much more. Now, a study of three closely related carnivorous plants suggests dextrous genetic shuffling helped them evolve the ability to catch and digest protein-rich meals.

Carnivorous plants have developed many devious ways to snare prey. Pitcher plants, for example, use "pitfall traps" that contain enzymes for digesting stray insects. Others—including the closely related Venus flytrap (*Dionaea muscipula*), the aquatic waterwheel plant (*Aldrovanda vesiculosa*), and the sundew (*Drosera spatulata*)—use moving traps. The sundew rolls up its sticky landing pad when mosquitoes get caught. And the Venus flytrap uses modified leaves, or pads, that snap shut when an insect lands—but only after the pads sense multiple touches on their trigger hairs.

To find out how these traps evolved, researchers led by computational evolutionary biologist Jörg Schultz and plant biologist Rainer Hedrich, both of the University of Würzburg, sequenced the genomes of the sundew, the aquatic waterwheel, and the Venus flytrap, which are all closely related. They then compared their genomes with those of nine other plants, including a carnivorous pitcher plant and noncarnivorous beetroot and papaya plants.

They found that the key to the evolution of meat eating in this part of the plant kingdom was the **duplication of the entire genome** in a common ancestor that lived about 60 million years ago, the team reports today in *Current Biology*. That duplication freed up copies of genes once used in roots, leaves, and sensory systems to detect and digest prey. For example, carnivorous plants repurposed copies of genes that help roots absorb

**Carnivorous plants have developed many devious ways to snare prey.**

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nutrients, to absorb the nutrients in digested prey. "That root genes are being expressed in the leaves of carnivores is absolutely fascinating," says Kenneth Cameron, a botanist at the University of Wisconsin, Madison.

Hedrich and his colleagues conclude that carnivory evolved once in the ancestor of the three species and, independently, in the pitcher plant. Adding these two new origins to others already documented, the researchers conclude that meat eating has evolved at least six times.

"The strength [of this study] is the comparative analysis," says Maria Logacheva, a plant scientist at the Skolkovo Institute of Science and Technology, who was not involved with the work. "It nicely shows how the novel traits emerge."

However, Victor Albert, a plant evolutionary biologist at the University at Buffalo, says Hedrich's team does not have enough data to support the two new origins, especially because some genes essential to predation existed in an earlier ancestor common to pitcher plants and the three newly sequenced plants. His team is sequencing two additional sundew species to help clarify what happened.

But Luis Herrera-Estrella, a plant genomicist at Texas Tech University, is pleased to know about the new genes that are now linked to carnivory. He and others can study how genes were rewired to make meat eating possible. Indeed, Hedrich says, it seems most plants already have many of the necessary genes. "The path to carnivory seems to be open for all plants."

sciencemag.org, 14 May 2020

<https://www.sciencemag.org>

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