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I DE LA SALUT DE CATALUNYA I DE BALEARS

SOCSA
SOCIETAT CATALANA DE SALUT AMBIENTAL

PRESCRIPCIÓ VERDA posicionament SOCSA sobre inhaladors

Dra M.Mar Gili Riu

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Membre fundador de la Societat Catalana de Salut Ambiental- ACMCB
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Catalunya 2030

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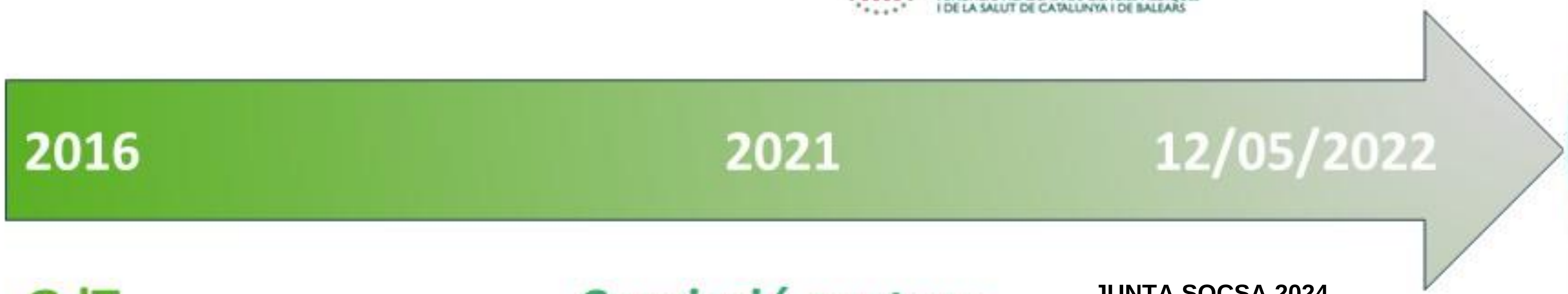

GdT Patologia ambiental

Comissió gestora
Societat catalana de salut mediambiental

JUNTA SOCSA 2024

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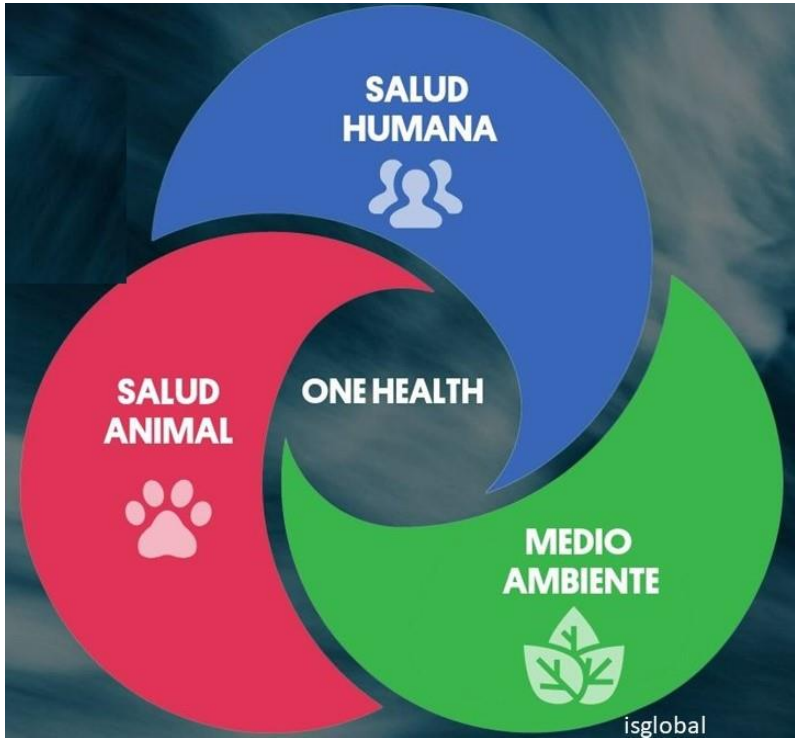


La Societat Catalana de Salut Ambiental, fundada el 12 de maig de 2022, emergeix com a resposta a la necessitat imperant d'unificar i coordinar equips multidisciplinaris dedicats a abordar els complexos desafiaments en l'àmbit de la salut ambiental.

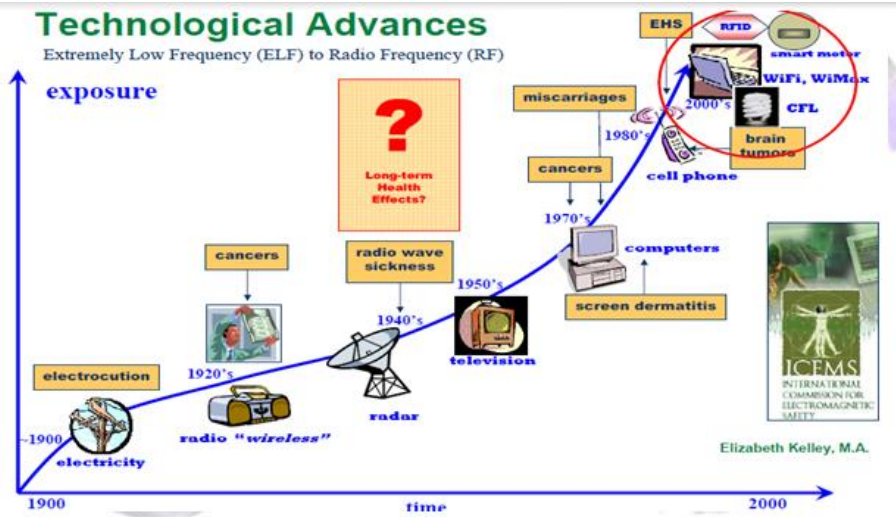
El nostre propòsit és consolidar el coneixement científic provinent de diverses disciplines, creant així un espai de sinergia on la col·laboració entre experts sigui la clau per a comprendre, prevenir i abordar les complexes interaccions entre l'entorn i la salut humana.

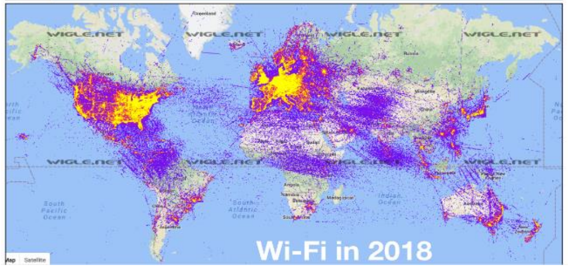
En promoure la col·laboració entre experts de camps com a medicina, biologia, química i enginyeria ambiental, es busca obtenir una comprensió més completa de les complexes interaccions entre l'entorn i la salut humana.

La nostra societat, sense ànim de lucre, té com a objectiu principal difondre els conceptes de la Medicina Ambiental entre totes les especialitats mèdiques i disciplines relacionades. Ens centrem en la docència, la recerca i la divulgació multidisciplinària, vetllant per la competència professional dels nostres socis i el prestigi ètic, social i científic d'aquesta branca transversal de la medicina.

La Medicina Ambiental és una ciència transversal, segons el Parlament Europeu (2008), que sorgeix no com a especialitat, sinó per enriquir les altres especialitats científiques.

ACCIÓ DE L'HOME SOBRE LA NATURA- ONHEALTH.



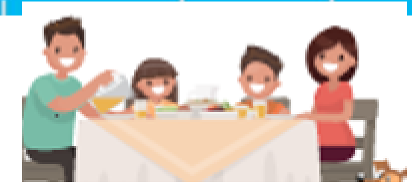


Desde 1965:
Creación comp. químicos más **4 millones**
Testados sólo 10% (COP-persistentes, universales, lipofílico y bioacumulables). **NANOPARTICULAS**

Desde **1980 CEM / tecnologías wireless:** incremento exponencialmente. OMNIPRESENTE.

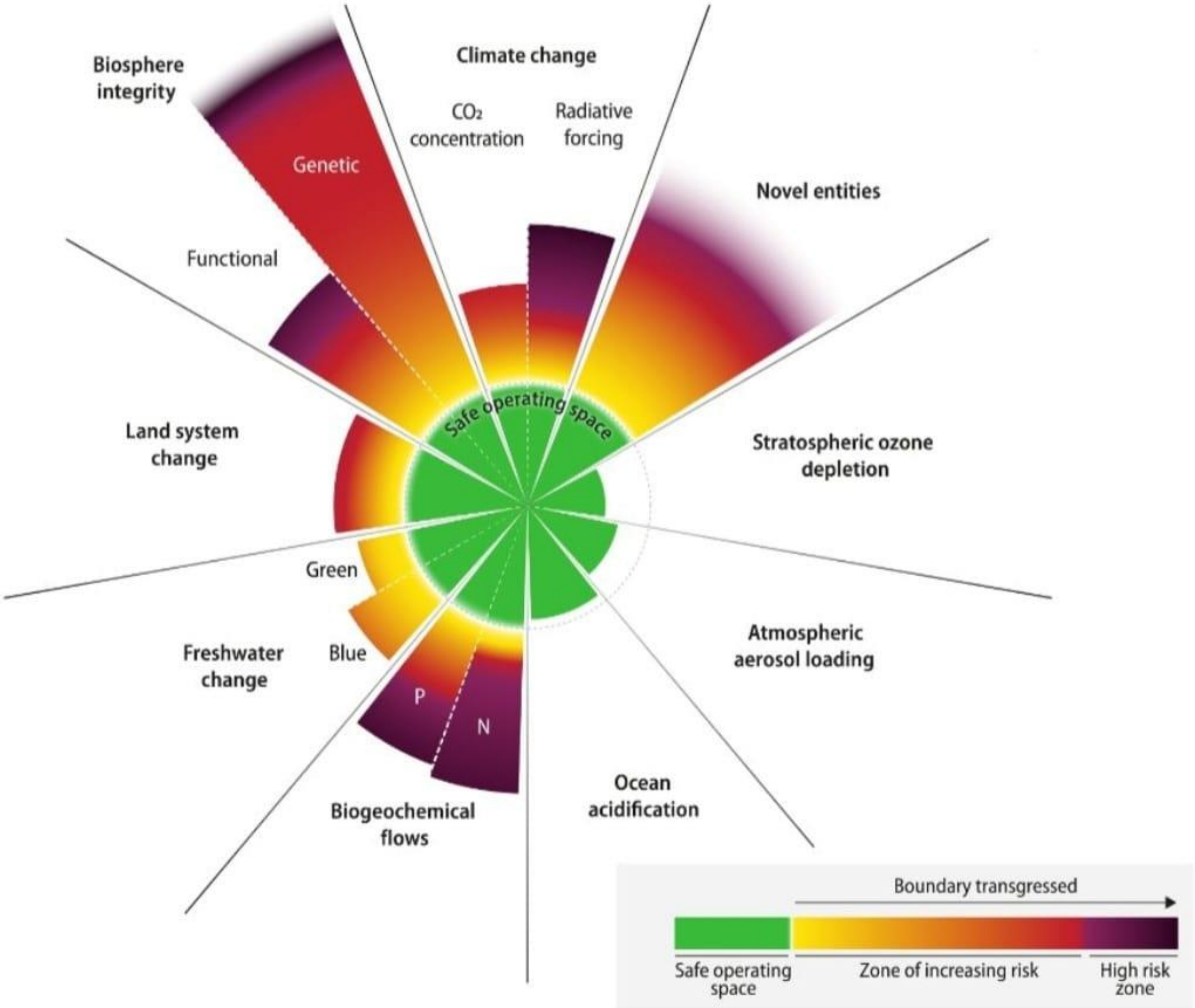
- Desforestación.
- Agotamiento de recursos.
- Contaminación de suelos, agua dulce, mar y aire (**CADENA ALIMENTARIA**)
- Alteración de los ecosistemas (especies en peligro de extinción)
- Cambio climático

Está amenazada la salud del Planeta, ecosistemas y humana



LA SALUT PLANETARIA

Gairebé 7/9 LÍMITS PLANETARIS estan afectats.
Està en risc l'equilibri d'autoregulació del planeta

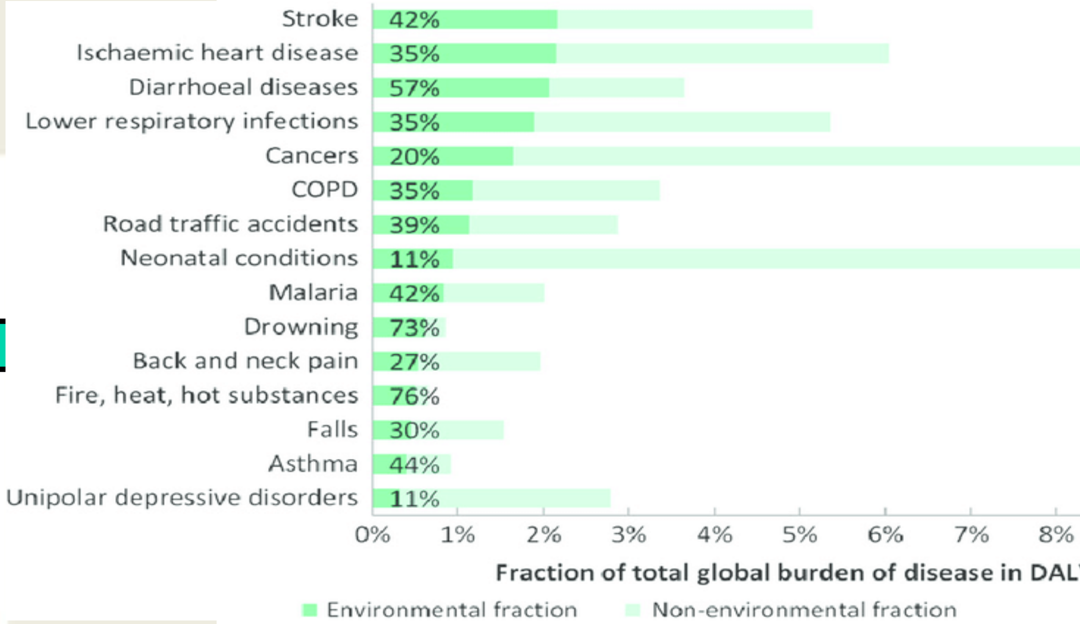


https://www.pik-potsdam.de/en/news/latest-news/earth-exceed-safe-limits-first-planetary-health-check-issues-red-alert

Determinants en salut humana

Modelo de Dahlgran y Whitehead

Dahlgren G, Whitehead M (1993). Tackling inequalities in health: what can we learn from what has been tried? Working paper prepared for the King's Fund International Seminar on Tackling Inequalities in Health, September 1993, Ditchley Park, Oxfordshire. London, King's Fund, accessible in: Dahlgren G, Whitehead M. (2007) European strategies for tackling social inequities in health: Levelling up Part 2. Copenhagen: WHO Regional office for Europe:http://www.euro.who.int/__data/assets/pdf_file/0018/103824/E89384.pdf.



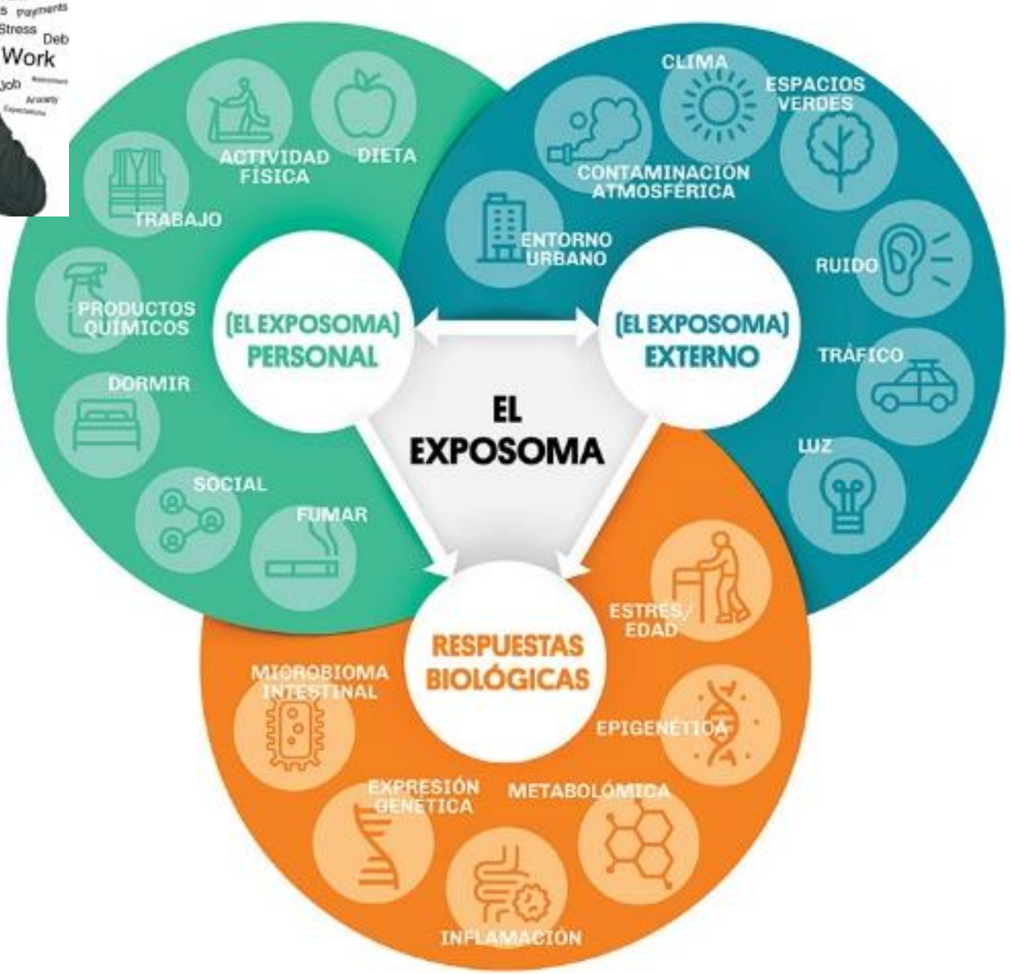
2/3 de les malalties són degudes a factors ambientals, no transmisibles

EPIGENÈTICA >>>> GENÈTICA

- **EXPOSOMA** 2005 Cristopher Wild : **El total de exposiciones ambientales desde el momento de la concepción a la que está expuesto un organismo, complementando el genoma- 2013** OMS/IARC

DINÁMICO MODIFICABLE

ISGlobal



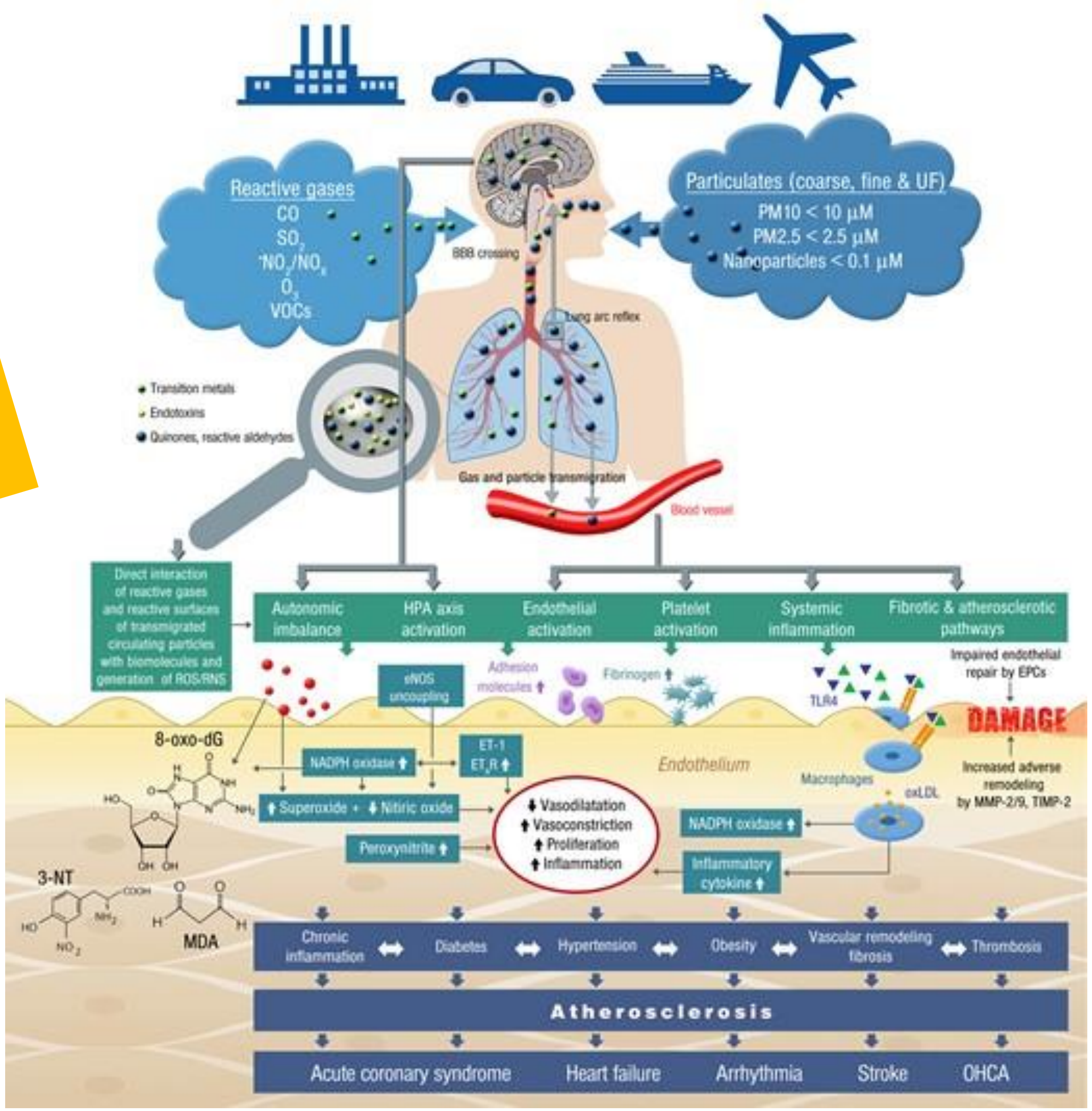
Fuente: www.projecthelix.eu

FACTORS PERTORBADORS TÒXICS DIARIS

Cada dia ens afrontem a:

1 kilo de menjar
2 litres d'aigua
10.800 litres d'aire

XENOBIÒTICS



ESC European Society of Cardiology
European Heart Journal: Acute Cardiovascular Care (2023) 00, 1–3
https://doi.org/10.1093/ehjacc/zuad132
EDITORIAL

Clearing the air, saving lives: understanding air pollution's impact on out-of-hospital cardiac arrest

Omar Hahad[1,2]*, Andreas Daiber[1,2], and Thomas Münzel[1,2]*

[1]Department of Cardiology—Cardiology I, University Medical Center of the Johannes Gutenberg-University Mainz, Langenbeckstraße 1, 55131 Mainz, Germany; and [2]German Center for Cardiovascular Research (DZHK), partner site Rhine-Main, Mainz, Germany

Online publish-ahead-of-print 9 November 2023

This editorial refers to 'Air Pollution and out-of-hospital cardiac arrest risk', by L. Moderato et al., https://doi.org/10.1093/ehjacc/zuad105.

El EXPOSOMA corresponde a la carga tòxica total o contaminantes a los que está expuesto cada organismo. Los contaminantes pueden ser :

- **QUÍMICO:** pueden actuar como disruptores hormonales, o como toxicos del sistema nervioso. Plaquicidas, biocidas. Retardantes de llama, compuestos volàtiles orgànicos (formaldehido), productos de limpieza, perfumes, metales (mercurio. Aluminio, fluor...)
- **FÍSICO** campos electromagnéticos, radiación ...
- **BIOLÓGICO**: virus. Hongos, bacterias intracelulares, paràsitos...
- **PSÍQUICO:** estrés

William J Rea. Sensibilidad Química. Principios y mecanismos. ed Fundación Alborada. 2016

Fernandez Sola J. Central sensitization syndrome: towards the structuring of a multidisciplinary concept. Med Clin (Barc) 2018 Feb1. pii:S0025-7753(17)309685-5. DOI: 10.1016/j.medcli.2017.12.006

GdT Grupos de Trabajo

Filial de Menorca

- Exposoma Biológico
- Exposoma Químico
- Exposoma Físico
- Cambio climático y medioambiente
- Agua
- Enfermedades ambientales
- Educación comunitaria
- Exposoma Psicosocial
- Bio-habitabilidad
- Odontologia ambiental
- Infanto-juvenil
- Salut digestiva i nutrició

Dra Silvia Martínez Marcos
Dra M. Jesús Clavera

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ELS INHALADORS

Els broncodilatadors obren els bronquis i permeten respirar millor a persones que pateixen malalties respiratòries com l’asma o la malaltia pulmonar obstructiva crònica.

INHHALADORS PRESSURITZATS
pMDI, Pressurized Metered Dose Inhaler

INHALADORS NO PRESSURITZATS
- inhaladors de pólvora seca (Dry Powder inhaler, DPI)
- inhaladors de boira fina (Soft Mist Inbhaler, SMI),

POSICIONAMENT SOCSA SOBRE INHHALADORS

El debat científic actual posa de manifest que les accions humanes estan canviant el clima mundial, amb repercussió en la salut planetària: la contaminació de l'aire, l'augment d'al·lèrgens, les pandèmies de zoonosi, malalties relacionades amb l'aigua i amb els aliments. Cada any, els factors ambientals causen al voltant de 13 milions de morts, que representen el 20% del total mundial. A nivell global, 9 de cada 10 persones respiren aire amb alts nivells de contaminants que superen els límits establerts per la Organització Mundial de la Salut (OMS).

La Conferència de les Nacions Unides sobre el Canvi Climàtic (COP28) ha conclòs amb un acord que assenyala el "principi de la fi " de l'era dels combustibles fòssils. El balanç de la ciència indica que les emissions mundials de gasos d'efecte hivernacle han de reduir-se en un 43% pel 2030, en comparació amb els nivells del 2019, per tal de limitar l'escalfament global a 1,5º C.

Per això calen mesures urgents per a reduir les emissions de diòxid de carboni (el gas d'efecte hivernacle dominant d'acció prolongada) i és responsabilitat de tots nosaltres com a societat i individus de contribuir a reduir les emissions de gasos d'efecte hivernacle i reduir l'augment de les temperatures.

A Espanya, els inhaladors pressuritzats convencionals (**pMDI, Pressurized Metered Dose Inhaler**) representen al voltant del 50% dels broncodilatadors totals utilitzats, això equival a 400.000 tonelades anuals de CO2. Aquesta xifra reflexa la magnitud de l'impacte ambiental associat amb l'ús generalitzat d'inhaladors convencionals en el tractament de malalties respiratòries. Segons el NHS, un dispositiu de pMDI produeix tants gasos efecte hivernacle com un viatge en cotxe de 300 km; en canvi un dispositiu no pressuritzat en produeix com un viatge de 6 km.

La Societat Catalana de Salut Ambiental SOCSA reconeix la importància d'abordar tant els aspectes mèdics de les malalties respiratòries com els seus impactes ambientals. A més , recolzem i promovem l'adopció d'inhaladors que contribueixin a disminuir la petjada del carboni i minimitzar els efectes negatius en la salut humana .

POSICIONAMENT SOCSA SOBRE INHHALADORS

El sistema sanitari, inclosa la prescripció farmacèutica, pot ser un important contribuent a la contaminació ambiental. Tots els fàrmacs tenen un impacte en el medi ambient: la petjada de carboni de la producció, l'emmagatzematge, l'empaquetat, el transport i la gestió dels residus (Annex 1) . Tanmateix, els inhaladors tenen un factor addicional: alliberen propel·lents i additius químics a l'atmosfera, contribuint a la contaminació i al canvi climàtic.

Els inhaladors pressuritzats convencionals, que utilitzen propel·lents químics com ara els **clorofluorocarbonis (CFC)** i el **hidrofluorocarbonis (HFC),** han estat tradicionalment associats amb una petjada de carboni significativa a causa de les emissions de gasos d'efecte hivernacle, molt potents durant la seva producció i ús, i contribueixen a l'esgotament de la capa d'ozó. Aquests propel·lents també poden tenir efectes adversos directes en la salut humana, inclosa la irritació de les vies respiratòries i l'agreujament de condicions respiratòries preexistents. Tanmateix, alguns estudis han suggerit una possible associació entre l'exposició als **fluorocarbonis** i una major risc de trastorns cardiovasculars, metabòlics , ossis i neurològics.

En contrast, els inhaladors no pressuritzats, com els **inhaladors de pólvora seca (Dry Powder inhaler, DPI)** i els inhaladors de **boira fina (Soft Mist Inbhaler, SMI),** tendeixen a tenir una petjada de carboni més baixa i no alliberen gasos d'efecte hivernacle durant el seu ús. Tanmateix , a l'evitar l'ús de propel·lents químics, aquests inhaladors poden reduir l'impacte en la salut humana associat amb l'exposició a fluorocarbonis. Es recomana a sanitaris fer una valoració individualitzada en el moment de la prescripció d'una teràpia inhalada i optar per dispositius de pólvora seca o boira fina si les característiques clíniques ho permeten. (Annex 2)

Per tant , la Societat Catalana de Salut Ambiental SOCSA treballa per aconseguir una aproximació planetària *one health* que consideri tan la salut humana com la salut del medi ambient. Això inclou, la promoció d'inhaladors que minimitzin la seva petjada de carboni i redueixin els efectes negatius en la salut humana, així com la implementació de pràctiques i polítiques que promoguin la prescripció racional de medicaments, la gestió adequada dels residus mèdics i la reducció de la contaminació farmacèutica en el medi ambient. Aquesta aproximació cerca protegir la salut de les generacions presents i futures, garantint un tractament efectiu i segur pels pacients amb afeccions respiratòries i promovent pràctiques sostenible i saludables en el sector

Carbon Footprint (kgCO2e per inhaler)	Inhaled Corticosteroid (ICS) containing inhalers			Non-ICS containing inhalers			
	ICS	ICS/LABA	ICS/LABA/LAMA	SABA OR SAMA	LABA	LAMA	LAMA/ LABA
Highest (>35 kgCO2e) Avoid unless no appropriate alternative		**Flutiform pMDI & K-haler** **Symbicort pMDI**		**Ventolin Evohaler**			
High (10-20 kgCO2e) Use only if low carbon footprint alternative not clinically appropriate	Clenil Modulite Kelhale Qvar Autohaler Qvar EasiBreathe Soprobec Alvesco Flixotide Evohaler	Fostair pMDI Seretide Evohaler Combisal AirFluSal pMDI Sirdupla Aloflute Sereflo	Trimbow pMDI Trixeo	Airomir AirSal Salamol Airomir Autohaler Salamol Easibreathe Atrovent	Serevent Evohaler Soltel Neovent Vertine Atimos Modulite		Bevespi
Low (<1kg CO2e) Use where possible	Beclometasone Easyhaler Budesonide Easyhaler Pulmicort Turbohaler Budelin Novolizer Flixotide Accuhaler Asmanex Twisthaler	Fostair Nexthaler Duoresp Spiromax Fobumix Easyhaler Symbicort Turbohaler Seretide Accuhaler Fusacomb Easyhaler Aerivio Spiromax AirFluSal Forspiro Stalpex Orbicel Fixkoh Airmaster Relvar Ellipta	Trelegy Trimbow Nexthaler	Salbutamol Easyhaler Salbulin Novolizer Ventolin Accuhaler Bricanyl	Foradil Formoterol Easyhaler Oxis Onbrez Striverdi Serevent Accuhaler	Spiriva Handihaler Spiriva Respimat Braltus Zonda Tiogiva Acopair NeumoHaler Incruse	Spiolto Ultibro Duaklir Anoro
THIS DOCUMENT WILL BE REVIEWED ON A 6 MONTHLY BASIS FOR CHANGES TO ALLOW FOR CHANGES IN AVAILABLE MEDICATIONS							

ANNEX 1: la petjada de carboni dels diferents dispositius de teràpia inhalada.

Extracte del *National Health Service, clinical networks* from London.

ANNEXE 2 : tria del dispositiu de la teràpia inhalada .

- La guia GEMA especifica que podria ser preferible l'ús de dispositius de pólvora seca o boira en nous pacients > 6 anys o amb flux inspiratori > 30l/min.

- La guia GEMA exposa que l'ús d'un SABA inhalat a demanda més de 2 cops al més per a tractar els símptomes (sense comptar quan s'utilitzi de manera preventiva abans de l'exercici), o el fet d'haver patit reaguditzacions en l'any anterior o un FEV1< 80%, indica un control de l'asma inadequat i requereix instaurar la teràpia de manteniment .

- La guia GOLD 2024 de la MPOC recomana en el maneig de les aguditzacions incrementar dosi i/o freqüències de SAMA i/o SABA ; combinar SAMA amb SABA (els tractaments Short habitualment van amb dispositius pressuritzats pMDi) . Recomana considerar l'ús de broncodilatadors de llarga durada LAMA / LABA quan el pacient s'estabilitzi / Els tractaments Long habitualment van amb dispositius DPI). És a dir, en l'estabilitat de la MPOC i tractament crònics, millor dispositius de pólvora seca DPI .

- Cal detectar l'abús de la teràpia de rescat amb pMDI i valorar pujar el tractament de base de llarg efecte amb dispositius no pressuritzats quan el pacient ho necessiti.

EXCIPIENTS INHALADORS PRESSURITZATS

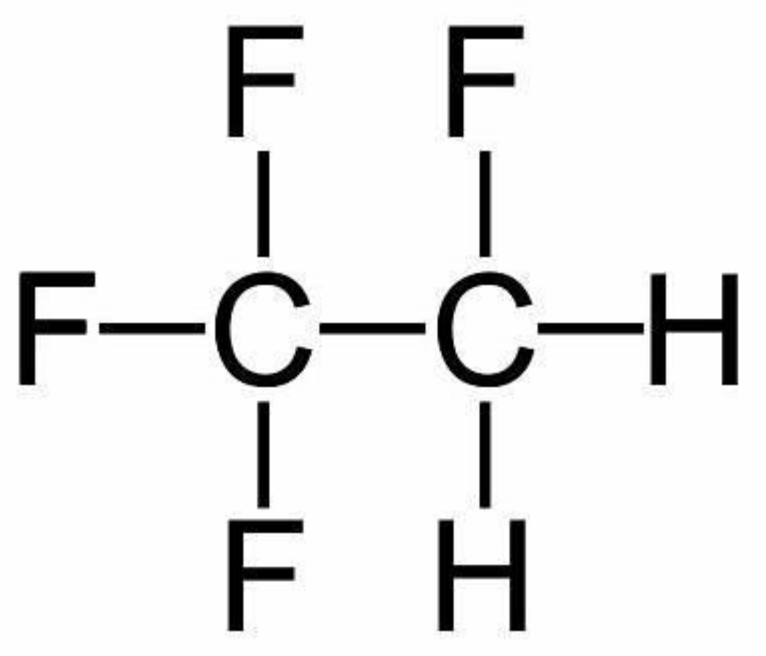
ECHACHEM
ECHA CHEMICALS DATABASE
Part of ECHA
EUROPEAN CHEMICALS AGENCY

Norflurane
EC number 212-377-0 • CAS number 811-97-2

Overview
Identity
Dossiers

Identifier	Value	Source(s)
IUPAC name	1,1,1,2 - Tetrafluoroethane	CLP notification
IUPAC name	Norflurane	CLP notification, REACH registration
IUPAC name	1,1,1,2 - tetrafluoroethane	CLP notification
IUPAC name	HFC-134a (Norflurane)	REACH registration
IUPAC name	1,1,1,2-tetrafluoroethane	REACH registration
IUPAC name	1,1,1,2-Tetrafluoroethane	REACH registration

FLUOROCARBONOS



https://www.techno-science.net/glossaire-definition/1-1-1-2-tetrafluoroethane.html

Los **fluorocarbonos** son compuestos químicos que contienen enlaces carbono-flúor. La relativamente baja reactividad y alta polaridad del enlace carbono-flúor los dota de características únicas. Los fluorocarbonos tienden a romperse muy lentamente en el medio ambiente y por tanto muchos se consideran contaminantes orgánicos persistentes. Muchos fluorocarbonos comercialmente útiles también contienen hidrógeno, cloro y bromo.

Enllaç fluoro-carbono indestructible per a la biologia

Tetrafluoetano es un gas que s'utlitiza en la indústria de la refrigeració i aires acondicionats.

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Feature

ILLUSTRATION BY ADRIÀ VOLTA

CAN THE WORLD LEAVE 'FOREVER CHEMICALS' BEHIND?

A European agency is considering a proposal to ban PFASs, the fluorinated chemicals used in jet engines, electric cars, refrigeration systems, semiconductors and many consumer products. By XiaoZhi Lim

This February, the European Chemicals Agency (ECHA) in Helsinki published a proposal that could lead to the world's largest-ever clampdown on chemicals production. The plan, put forward by environmental agencies in five countries – Denmark, Germany, the Netherlands, Norway and Sweden – would heavily restrict the manufacture of more than 12,000 substances, collectively known as forever chemicals.

https://echa.europa.eu/es/regulations/reach/understanding-reach

ECHA EUROPEAN CHEMICALS AGENCY

Febrer 2024 l'agència de químics europea ECHA fa una proposta de restringir les substàncies perfluorades PFOAS

https://pubmed.ncbi.nlm.nih.gov/37528170/

PFASs are extraordinarily useful. Their fluorine-swaddled carbon chains let grease and water slide off textiles, and they protect industrial equipment from corrosion and heat damage. But their strong carbon–fluorine bonds cannot be broken apart by natural processes.

These chemicals, per- and poly-fluoroalkyl substances (PFASs), are all around us. They coat non-stick cookware, smartphone screens, weatherproof clothing and stain-resistant textiles. They are also used in microchips, jet engines, [illegible] and [illegible]igeration systems.

PFASs are extraordinarily useful. Their fluorine-swaddled carbon chains let grease and water slide off textiles, and they protect industrial equipment from corrosion and heat damage. But their strong carbon–fluorine bonds cannot be broken apart by natural processes. So after PFASs escape from factories, homes and vehicles into the environment[1], they add to a forever-growing pollution problem. The February proposal estimates that [illegible] thousands of tonnes of these [illegible] escape annually [illegible].

Several PFASs are now known to be toxic. They have been linked to cancers and damage to immune systems, and are now banned under national and international laws. Most PFASs, however, have not yet undergone toxicology assessments or been linked to health harms. But officials at the agencies that submitted the plan to the ECHA say their persistence means they will inevitably build up until as-yet unknown safe thresholds are crossed.

"We see that there is an unacceptable risk now," says Richard Luit, a policy adviser at the Dutch National Institute for Public Health and the Environment in Bilthoven.

There's no prospect of an instant ban. The ECHA is consulting on the idea before it takes a position. European legislators are unlikely to have a plan to vote on before 2025, and even the current proposal offers grace periods — of more than a decade in some cases — to allow manufacturers to develop alternative materials or systems. Several permanent exemptions are also offered (including for fluorinated drugs, such as Prozac, and for materials used to calibrate scientific instruments).

But taken as a whole, the idea is to shrink PFAS use to a minimum. "We are asking society to make quite a shift," says Luit. "We are asking to reverse all of it, go back to the drawing ta[illegible] and invent alternative solutions."

Change is already under way fo[illegible] consumer use of PFASs. The notoriety of t[illegible] toxic examples has pushed more than 10[illegible] companies and brands, including Apple, to [illegible]ledge to phase out PFASs, even before it's c[illegible]ar whether other materials can do the same j[illegible]b.

For industrial users, how[illegible]er, the idea of life without PFASs is a more sho[illegible]ing prospect. So February's proposal has ignit[illegible] debate about which uses of fluorinated chem[illegible]s the world could leave behind — and which m[illegible] stay.

Three forms of forever

A peculiarity with fluorinated compounds, researchers say, is that some kill, whereas others are safe enough for use in medical products. "Fluorine compounds are really, really, incredibly strange in this regard," says Mark McLinden, a chemical engineer at the US National Institute of Standards and Technology in Boulder, Colorado. "Certain fluorine compounds are incredibly toxic. And then you have things like [the gas] R134a, which is be[illegible] enough that you're shooting it directly into yo[illegible] lungs in asthma inhalers".

Forev[illegible] chemicals come in three distinct forms (see '[illegible]luorinated world'). The notoriously toxic [illegible]ds are fluorosurfactants. These molecules [illegible]semble those in soap, made of two parts: [illegible]rbon chains with fluorine atoms wrappe[illegible] around them, that repel [illegible], and [illegible]ater-loving portion [illegible] end of the [illegible]ains that allows the [illegible]ecules to dissolve in water.

After some of [illegible]se molecules were linked to serious he[illegible]th harms and widespread water pollut[illegible]n, individual substances were banned or se[illegible]erely restricted internationally: first PFOS ([illegible]erfluorooctanesulfonic acid) in 2009, then [illegible]OA (perfluorooctanoic acid) in 2019, and, la[illegible] year, PFHxS (perfluorohexanesulfonic acid). [illegible]anufacturers have moved on to other fluoros[illegible]factants, many of which lack toxicity studies.

> "We need lots of m[illegible]erials that have not been inven[illegible] that are fluorine-free."

The February proposal suggests phasing out all the fluorosurfactants at once to avoid "regrettable" substitutions, says Jona Schulze, a staff scientist at the German Environment Agency in Dessau-Roßlau.

But the proposal goes further than that. The five agencies behind it have adopted the Organisation for Economic Co-operation and Development's definition of PFASs: any molecule with a carbon atom in a chain that's bonded to [illegible] if at the end [illegible] chain, three). Restrictions under [illegible] expansive definition cover the other two kinds of forever chemicals.

There are the fluoropolymers, the plastic-like form that most consumers encounter. The most famous example is Teflon, or polytetrafluoroethylene (PTFE), long carbon chains wrapped in fluorine atoms. A Teflon-based coating makes frying pans non-stick; in medical products, it helps catheters to glide through the body, safeguards implants from deterioration, and, coated on the inside of bottles and blister packs, prevents drugs from interacting with their glass or foil containers. Stain-resistant textiles use a variant of this structure, in which fluorine-wrapped side chains [illegible] off a main carbon chain.

The third category of PFASs is made up of small, light fluorocarbon molecules that generally exist as gases or liquids. R134a, the asthma-inhaler propellant, is also a common refrigerant in refrigerators and mobile air-conditioning systems, for instance. Sensitive equipment that is prone to overheating, such as servers in a data centre, can be submerged in fluorocarbon fluids that cool the apparatus without shorting its circuits or running the risk of fire.

Although fluoropolymers and fluorocarbons haven't been shown to harm consumers directly, the problems come when they're produced and when their useful lives end. Fluoropolymers are created using toxic fluorosurfactants, [illegible] pollute water and soil around fluoropolymer p[illegible] worldwide. Some researchers also suspect that [illegible]opolymers might, during their long lifetimes, [illegible] fragments small enough to be ingested, a[illegible] known to happen with microplastics (Nature 593, 22–25; 2021). As for the fluorocarbons, some are powerful greenhouse gases, and others break up into a small-molecule PFAS that is now accumulating in water.

"If no action is taken, at some point the societal costs due to continued use are likely to exceed the costs which are now associat[illegible] with their restriction," says Schulze.

The electric-car conundru[illegible]

To see all three for[illegible] PFAS in one [illegible] further than cars. Their air-conditioning systems use a fluorocarbon refrigerant, the hydraulic fluids usually contain fluorosurfactant additives that prevent corrosion, the painted chassis probably has a weatherproof fluoropolymer coating, and the seats are usually covered in a stain-resistant fluorinated textile.

Electric vehicles are even more reliant on fluoromaterials because of their lithium-ion batteries. These batteries get their high energy density, and therefore range, by operating at relatively high voltages, explains Gao Liu, a chemist at Lawrence Berkeley National Laboratory in Berkeley, California. The metallic content in their cathodes is usually a powder [illegible] must be bound together with a material that [illegible] withstand the high voltage. In the 1990s, tha[illegible] PTFE; today, battery makers use a cheaper flu[illegible]polymer called polyvinylidene fluoride (PVDF), containing half the fluorine.

Smaller fluori[illegible]ed molecules have become crucial, too. Ad[illegible]ng them to battery electrolytes allows a [illegible]rotective layer of lithium fluoride to form o[illegible] the electrodes, improving performance an[illegible] extending lifetime by preventing crack[illegible] says Cheng Zhang, a chemist at the Univ[illegible]ty of Queensland in Brisbane, Australia. [illegible]is area has become a battleground for b[illegible]ry manufacturers, who are developing [illegible] details of fluorinated additives.

Liu has developed a fluorine-free binder, but it works only for a lower-voltage battery such as one based on lithium iron phosphate.

And thenyou have things like [the gas] R134a, which is benign enough that you're shooting it directly
into your lungs in asthma inhalers".
As for the fluorocarbons,
some are powerful greenhouse gases, and others break up into a small-molecule PFAS that is now accumulating in water.

The five agencies behind it have adopted the Organisation for Economic Co-operation and Development's definition of PFASs: any molecule with a carbon atom in a chain that's bonded to two fluorine atoms (or, if at the end of the chain, three)

Feature

These batteries do have advantages: they last longer and don't use critical minerals such as cobalt, nickel or manganese, important factors to consider as battery production ramps up in the fight against climate change, Liu says. But even though lithium iron phosphate batteries would work for stationary storage and already power half of Chinese electric vehicles, they might not be cost-effective for long-range vehicles.

"The whole field needs to look into better chemistries," says Liu. "The reason we switch to batteries is to protect the environment. It doesn't make sense to invent something that's dirtier than before."

The hydrogen economy

The push for clean energy involves fluoromaterials on another front: building the hydrogen economy. Central to this effort are electrolysers that generate 'green' hydrogen by splitting water, powered by renewable electricity.

The fluctuations of wind and sun favour a type of electrolyser that uses a proton-exchange membrane system (PEM). Such systems can ramp up and down quickly, unlike an older, well-established electrolyser for splitting water. As the name suggests, PEMs involve membranes that control the movement of protons (that is, positively charged hydrogen ions) between electrodes. Fluorinated materials are favoured for the membrane because they can tolerate the acidic operating conditions.

Seeking to enter green hydrogen production, the fluorochemicals manufacturer Chemours this January announced a US$200-million expansion in France to produce more of its fluorinated Nafion membrane. (Nafion is currently used for the valuable chlor-alkali process, which splits brine into chlorine and sodium hydroxide, products that in turn are used in half of all industrial chemical processes.)

But PFASs aren't necessary for green hydrogen: an emerging alternative to PEMs involves systems that instead move negatively charged hydroxide ions across membranes in an alkaline environment, says Benjamin Britton, a chemist who co-founded the start-up Ionomr Innovations in Vancouver, Canada. Ionomr is among firms creating non-fluorinated membranes for such anion-exchange systems[2].

It could prove harder to replace Nafion in the chlor-alkali process, however: there, fluorinated membranes are better than other materials at withstanding corrosive chlorine attack. Still, some researchers are studyin[illegible] whether this process can work without me[illegible]branes at all.

The refrigeration battle

By far the largest source of PFAS emiss[illegible]ns comprises the light fluorocarbon gases. T[illegible]ir main application is as refrigerants. Altho[illegible]h ammonia, an early refrigerant, is still us[illegible] for industrial applications, it was fluorinated compounds, specifically chlorofluorocarbons (CFCs), that brought air conditioning and refrigeration to the masses. That's because, unlike ammonia, they are not irritants and they are non-flammable, says McLinden.

CFCs were phased out because they deplete atmospheri[illegible]ed by hyd[illegible]rocarbons such as R134a. But th[illegible] greenhouse gases — and so there is an ongoing switch to hydrofluoroolefins (HFOs)[3]. These contain a double bond between two carbon atoms, a link that's susceptible to attack by atmospheric compounds, which helps these molecules to break apart in weeks.

Problem solved? Not exactly. Environmental scientists and officials are now advocating the phasing out of HFOs because those molecules break up in the atmosphere to form a [illegible]S called trifluoroacetic acid or TFA. Karsten Nöd[illegible]analytical chemist at the Ge[illegible] Water Centre[illegible]ough TFA has not been linked to any health issues, its accumulation warrants concern because it is extraordinarily difficult to remove from water. Should the time come when a clean-up is required, the only option will be reverse osmosis, an expensive technique of last resort.

Other than ammonia, the fluorine-free refrigerant options are hydrocarbons, which are flammable, or carbon dioxide, which suffers efficiency losses, especially in hot weather when cooling is needed most, McLinden says. European refrigerators already use hydrocarbons, but these substances might pose too great a fire risk in large air-conditioning systems, for example. Air conditioners for small residences have become safe enough for hydrocarbons, argues Audun Heggelund, a senior adviser to the Norwegian Environmental Agency in Oslo. The February proposal gives the air-conditioning industry 12 years to switch to hydrocarbons, but it grants a permanent exemption where safety codes prohibit the use of flammable refrigerants.

McLinden suggests that a common-sense approach is to crack down on leaks. Refrigerants operate in a closed loop — in that if they leak, the device doesn't work. So if manufacturers could assure no leaks, any refrigerant would be fine, he argues.

Heavy industries

The simplest but most pervasive uses of PFASs in machinery — from engines to chemical reactors — are at the interfaces between parts. Fluoropolymer greases lubricate moving surfaces, and fluoroelastomer O-rings, gaskets and seals join parts together. (Elastomers are polymers that regain their shape after being deformed.) Fluoromaterials are the only flexible ones that can resist aggressive chemical corrosion, very high temperatures and, in some applications, ultraviolet radiation, says Michael Eason, a materials engineer at James Walker, a

FLUORINATED WORLD

The European Chemicals Agency has proposed restricting all PFASs (per- and poly-fluoroalkyl substances). More than 12,000 of these 'forever' chemicals are known; they fall into three broad classes.

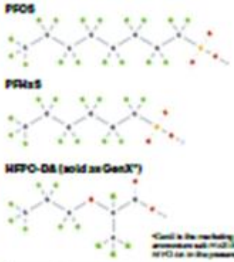
Fluorosurfactants
Soap-like molecules with water-loving heads and fluorine-wrapped carbon tails. Some are notoriously toxic and have been banned.

- Carbon - Fluorine - Sulfur
- Oxygen - Hydrogen

PFOS

PFHxS

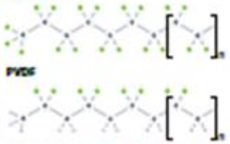
HFPO-DA (sold as GenX*)



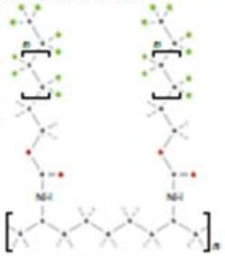
Fluoropolymers
Long polymer (plastic-like) chains of carbon wrapped in fluorine. Made using fluorosurfactants.

PTFE ('Teflon')

PVDF



Side-chain fluorinated polymers
Polymers used in textiles often have fluorinated side chains that might break off during washing (conceptual example shown).

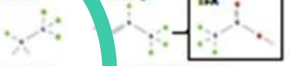


[illegible]
[illegible] gases and liquids.

R134a

HFO1234yf

TFA



Used in air-conditioning systems and asthma inhalers. A greenhouse ga[illegible]

[illegible] non-greenhouse-gas [illegible]placement for R134a. However, [illegible]ce in the atmosphere, it breaks [illegible]part into TFA, whose accumulating levels worry some researchers.

R134a. But these
are greenhouse gases — and so there is an ongoing switch to hydrofluoroolefins (HFOs)[3].
These contain a double bond between two carbon
atoms, a link that's susceptible to attack by atmospheric compounds, which helps these molecules to break apart in weeks.
Problem solved? Not exactly. Environmental scientists and officials are now advocating the phasing out of HFOs because those molecules
break up in the atmosphere to form a
PFAS called trifluoroacetic acid or TFA.

company headquartered in Woking, UK, that manufactures high-performance sealing products. Fluoroelastomer seals are also usefully non-stick when equipment is disassembled for maintenance.

Fluoromaterials' resistance to heat alone sets them apart from other soft materials: PTFE, for instance, can withstand a constant temperature of 260 °C for 10 years while losing only 1% of its mass, says Barbara Henry, a materials scientist at W. L. Gore, a materials-science company based in Newark, Delaware. This allows seals to last the lifetime of their equipment, for instance in an oil-well head, minimizing maintenance and therefore worker exposure to occupational hazards. It also allows machinery such as jet engines to operate at higher temperatures, and therefore more efficiently. "Because fluorinated polymers exist, every piece of equipment that's followed a capitalist process, trying to get faster, quicker, more efficient, has adopted fluorinated materials," says Eason.

PTFE also protects workers in heavy industries. A thin internal layer of PTFE in multilayered textiles allows garments to remain light and breathable while providing enough heat resist[illegible] and arc flashes, the explosive electrical discharges that can melt textiles o[illegible]o skin. Gore has [illegible]oped fluorine-free w[illegible]therproof ou[illegible]r for consumers (using [illegible]), but high-performance gear still de[illegible]nds PTFE, says Henry.

Aware of the push to ban PFASs, how[illegible]er, Eason and Chaoying Wan, a materials scien[illegible] at the University of Warwick, UK, are starting a collaboration to find alternatives. A replacement that has all the properties of PTFE would be "almost impossible" to find, Eason says. But substitutes could emerge for applications where just one or two properties of PTFE are needed, although this would complicate supply chains. Eason expects that the outcome might be dozens of specialized products, whereas now a handful of fluoropolymers meet the needs of industries ranging from aerospace to pharmaceuticals to semiconductors.

Computer chips

Fluorochemical producers are also buoyed by the world's race for semiconductor dominance. Last September, Chemours announced an expansion at its North Carolina facility to support domestic semiconductor production. And this year, Asahi Glass Company, a chemicals and glass manufacturer in Tokyo, also cited strong demand from the semiconductor industry when it announced a ¥35-billion ($250-million) expansion in fluorochemicals production.

PFASs are used in many ways to make computer chips. In one crucial step, manufacturers coat a silicon wafer's surface with a 'photoresist' material containing PFASs: when the photoresist is illuminated, those PFASs generate strong acids that eat away at portions of the material, leaving a carefully patterned gap. In a second step, the exposed parts of the wafer are etched away — and in 'dry etching', a mixture of gases is used, usually containing some fluorocarbons. (Fluoropolymers are also used in a variety of microchip coatings.)

It is not easy to find alternatives to the strong acids or the etching gases. Fluorine atoms impart the necessary acidity, and fluorocarbon gases are prized for their precision in etching. The Semiconductor Research Corporation, a consortium based in Durham, North Carolina, is promoting research into ways to limit PFAS emissions and to find alternatives in the microchip industry.

In one case, companies have managed to ditch a small use of fluorosurfactants in 'wet etching' — processes that involve chemicals in solution. Here, fluorosurfactants helped the solutions to spread over the surfaces to be etched, says Christopher Christuk, president of electronic chemicals supplier Transene in Danvers, Massachusetts. Transene is now using fluorine-free surfactants that were identified by researchers at the University of Massa[illegible]upport [illegible]his switch came from the Massach[illegible]

"A responsible company should be looking to minimize the use of fluorinated materials."

Tox[illegible] Reduction Institute, a [illegible]gency funded by [illegible]sses that use toxic chemicals, which set up the partnership between Transgene and UML and funded the research project, Christuk says.

The magic of fluorine: myth or fact?

Industries that have known nothing but fluorine chemistry need to break away from believing in its magic, says Martin Scheringer, an environmental scientist at the Swiss Federal Institute of Technology in Zurich (ETHZ). "PFASs are a block to innovation," he says, pointing to the example of firefighting foams. Despite making foams from PFOS for decades, the multinational technology company 3M managed to create fluorine-free firefighting foam in 2002, but only after PFOS became a high-profile pollutant. Many other industries now need to make similar breakthroughs. "We need lots of materials th[illegible]en invented that are fluorine-[illegible]," Scheringer s[illegible].

In De[illegible]ember, 3M anno[illegible]ced it would stop ma[illegible]g all its fluoroch[illegible]ical products — includi[illegible]uoropol[illegible] and fluorocarbon gases and [illegible] — by 2025, but did not say what would take their place. This June, it reached a $10-billion settlement to pay to clean fluorosurfactants from drinking water in parts of the United States, although it faces other unresolved lawsuits.

For the moment, most of the funding granted to PFAS topics relates to cleaning up pollution, and neither of the huge government-funded European Union or US programmes to boost clean energy or the manufacture of semiconductor chips specify the need to find alternatives to PFASs. "We should channel more of the funding to the research that will find new solutions," says Jonatan Kleimark, an adviser at ChemSec, a non-profit organization based in Gothenburg, Sweden, that advocates for safer chemicals.

Eason and Wan are trying to find ways to manufacture fluoropolymers without using toxic fluorosurfactants. If that can be achieved, Eason argues, it should be fine to continue using fluoropolymers where they cannot be substituted, provided that recycling at the end of their life is also resolved. But Eason recognizes the problem of persistence with fluoropolymers. "The ECHA proposal has made everyone realize they have to do something different," he says. "In my view, a responsible company should be looking to minimize the use of fluorinated materials."

The officials who proposed the ban say that [illegible]ey welcome proposals from manufacturers t[illegible]xtend producer responsibility and develop clo[illegible]d-loop systems for recycling fluorochemical[illegible] "They have to provide the information an[illegible]ep forward," says Heggelund. But he is hi[illegible]ly sceptical, noting the low rates of plas[illegible] recycling. And if fluoropolymers could be made without toxic surfactants, then manufacturers should have done it from the start instead of reacting to regulation, he says.

The ECHA is collecting feedback on the proposal until the end of September. After that, it will revise the plan and carry out a techno-economic assessment to evaluate the costs and benefits for society.

The agency is the only one in the world contemplating such comprehensive PFAS restrictions. But enacting a ban would send a signal to the rest of the world about the acceptability of the chemicals. Zhanyun Wang, an environmental scientist at ETHZ, thinks that the proposal will spur innovative research for applications that don't have obvious alternatives to fluorinated chemicals. And for those that do, Wang hopes the proposal and market changes that follow could act as a "lighthouse", as he puts it: showing industries around the world how to ditch forever chemicals for good.

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1. Evich, M. G. et al. Science 375, eabg9065 (2022).
2. Moreno-González, M. et al. J. Power Sources Adv. 19, 100109 (2023).
3. McLinden, M. O., Seeton, C. J. & Pearson, A. Science 370, 791–796 (2020).
4. Sharma, R. et al. J. Cleaner Prod. 415, 137879 (2023).

A responsible company should be looking to minimize the use of fluorinated materials.

PFAS, PFOS

DISRUPTORS ENDOCRINS

https://www.aesan.gob.es/AECOSAN/docs/documentos/noticias/2019/Disruptores_endocrinos.pdf

2.2.3 Perfluoroalkyl substances (PFASs)

PFASs are primarily used in food contact materials for their water and oil repellent characteristics. That they can migrate into food [137] and increase blood PFAS levels is known and has been underlined in the Madrid statement on PFASs [138]. Intake of fast food was associated with increased levels of different PFASs, including perfluorononanoic acid (PFNA), whereas increased use of canned food was positively associated with perfluorohexane sulphonic acid (PFHxS) [139]. Different PFASs have been reported in pizza boxes and in pre-prepared bags for popcorn [140]. Consumption of fast food has been associated with higher PFAS levels and decreased circulating thyroid hormones [141].

The complexity and the continually changing profile of PFAS production makes it difficult to have an exhaustive characterization of their effects, in addition to the very different metabolism of PFOA between humans and rodents. In spite of this, effects of several PFASs have been identified. These include effects of PFASs on thyroid hormone levels during pregnancy and in childhood [142, 143] and on the thyroid axis [142, 144, 145][12]. With respect to neurodevelopmental disorders, certain longitudinal studies have reported effects of prenatal PFAS exposure on increased hyperactivity, conduct problems and a composite score for autism screening [146] whereas other studies have been less conclusive [147, 148]. In many studies, most of the PFASs measured (up to 16) were present in above 90 % of samples.

Immune responses have also been documented as associated with PFAS levels [149, 150], but whether this implicates an endocrine mechanism remains to be investigated. However, many nuclear receptors are expressed in different immune cells [151]. Hence, the possibility that endocrine mechanisms are implicated should be investigated. Effects on weight gain are also plausible for some PFAS [152], as is an effect of PFOA on ulcerative colitis, an autoimmune disease [153]. Associations of PFOA exposure with kidney and testis cancer incidence in human populations exposed from drinking water following an industrial contamination have also been reported [154]. Effects on liver function have also been reported in humans [155].

PRINCIPI DE PRECAUCIÓ

[11] https://ec.europa.eu/growth/sectors/chemicals/reach/restrictions_en

[12] See also the evaluation from C8 project regarding thyroid disease:


Economia Circular
al sector Sanitari
Estudi Sectorial
SOCSA
SOCIETAT CATALANA DE SALUT AMBIENTAL
ClubEMAS
asociación de organizaciones registradas EMAS en Cataluña
Catalunya 2030
posicionament SOCSA sobre inhaladors
info@socsa.cat

PETJADA CLIMÁTICA DEL SECTOR SANITARI

La **huella climática del sector** de la salud equivale a las **emisiones anuales de gases de efecto invernadero de 514 centrales eléctricas de carbón** de forma que, si el sector fuera un país, sería el **quinto emisor más grande del planeta** según el documento.

El informe se titula '*Huella climática del sector de la salud. Cómo contribuye el sector de la salud a la crisis climática global: oportunidades para la acción*'. Este documento ha sido elaborado en colaboración con la compañía Arup y basa sus consideraciones en **43 países**.

> *Si el sector de la Salud fuera un país sería el quinto emisor más grande del planeta*

Informe: 'Huella climática del sector de la salud. Cómo contribuye el sector de la salud a la crisis climática global: oportunidades para la acción' de Salud Sin Daño

Uno de los principales datos que indica el documento es el porcentaje de las emisiones del sector: el **4,4 por ciento de las globales netas**, o lo que es lo mismo a **2 gigatoneladas de carbono**. Unas cifras que sitúan al sector salud como "uno de los principales responsables de la crisis climática".

En 2018, el Grupo Intergubernamental de

hazrevista.org

https://gacetamedica.com/investigacion/cuanto-contamina-sector-salud-planeta/

PROPOSTES PER A QUE EL SECTOR SANITARI SIGUI MÉS RESPECTUÓS AMB EL MEDI AMBIENT

A nivell institucional

- Gestió residus, equipaments, transport
- Gestió edificis verds-bioarquitectura
- Educació a la població des de salut pública en prevenció
- Potenciar la investigació per poder utilitzar químics de neutres en emissions i segurs per la salut humana.
- Assegurar una bona legislació i compliment de les recomanacions científiques.

- A nivell facultatiu
- seguretat del pacient
- Revisió de prescripcions farmacològiques
- Revisió dels sobrediagnòstics
- Més plaça – social
- Més parc- exercici físic
- Més educació nutrició

- EN MEDICINA AMBIENTAL:
- CONTROL AMBIENTAL,
- RASTEIG DE L'EXPOSOMA INDIVIDUAL
- EVITAR TÒXICS
- HÀBITS DE CONSUM
- ESTILS DE VIDA
- FORMACIÓ A PROFESSIONALS I POBLACIÓ GENERAL
- MEDICINA DE PRECISIÓ PERSONALITZADA

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