3M Science. Applied to Life.™

Meeting with the EU Commission

[redacted]

Brussels, 6 October 2022

Proposed Agenda

- Introduction to 3M: global technology company deeply invested in Europe

- 3M as a responsible manufacturer
- Specialty materials/chemicals critical for achieving EU policy objectives
- Health Science on chemicals/PFAS

- Recommendations from 3M re. the Green Deal and regulating chemicals/PFAS: need for a balanced & science-based approach

3M as a technology company & responsible manufacturer

Who We Are & What We Do

Applying our science to improve every life

Safety & Industrial

Accelerating safety and industry performance by serving the industrial, electrical and safety markets.

Transportation & Electronics

Moving transportation and a connected world forward by serving automotive and electronic OEM customers.

Health Care

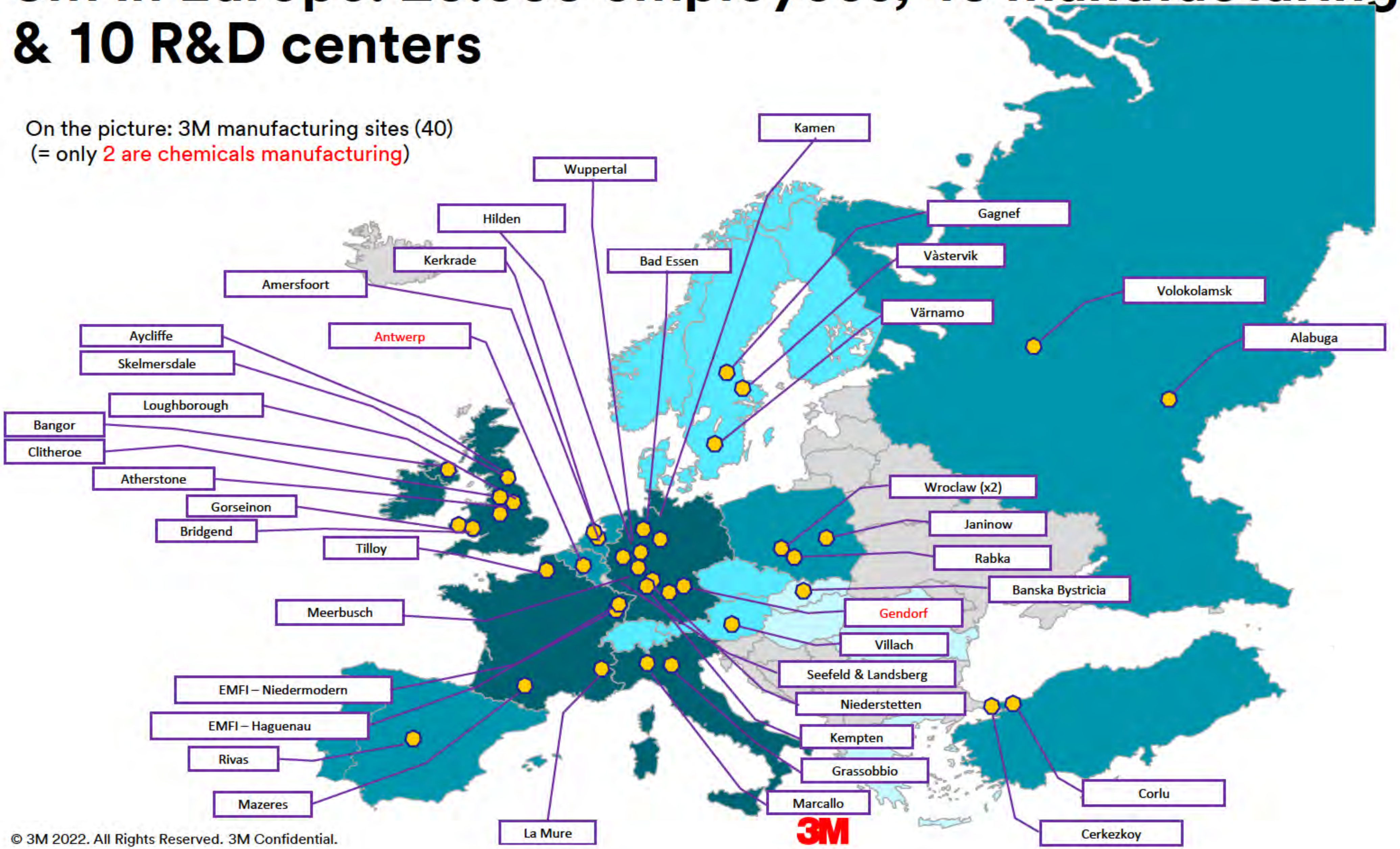
Connecting people, insights, science and technology to make better health possible around the world by serving the health care industry.

Consumer

Innovating to simplify life and work by serving global consumers.

3M in Europe: 20.000 employees, 40 manufacturing sites & 10 R&D centers

On the picture: 3M manufacturing sites (40)
(= only 2 are chemicals manufacturing)



New Carbon & Water commitments

Building on 3M Sustainability Strategic Framework

Science for Circular

Our **water goals** will **reduce water use** by 25% in our facilities (10% by 2022, 20% by 2025 & **25% by 2030**), **and improve water quality** when returned to the environment after use in our manufacturing operations

Science for Climate

Our **carbon goal** will make 3M achieve **carbon neutrality in operations by 2050** while aiming for a 50% reduction of carbon emissions by 2030 and 80% by 2040 (note: 2019 is the baseline measure year)

Science for Community

Our **social goals** expand opportunities for underrepresented communities to participate and succeed in the future workplace, and make 3M **lead in social equity and justice**

Reducing PFAS discharges by more than 99% by 2024

3M is Managing Current Operation

- 3M is investing in new technologies to further reduce process discharges, with a goal of reducing PFAS discharges by more than 99% of PFAS from site water discharges by 2024 (from 2019 levels).

3M is Managing Legacy Contamination

- While 3M takes action to address current manufacturing, the company is also making progress to address legacy materials. 3M has publicly committed to carry out remedial actions as informed by the soil investigation process.

Example:
Granular activated carbon water treatment (= eliminates wide variety of contaminants besides PFAS)

Perception: *PFAS can't be treated*
Reality: Well-known, scaled methods already exist to eliminate PFOA and PFOS from water

Specialty materials for achieving EU policy objectives

Specialty materials: example of PFAS

PFAS have many different properties. Grouping is not appropriate.

We would never group them together and say: “they are similar”, because **<u>they are NOT</u>**

C-F COMPOUNDS:

C-H COMPOUNDS

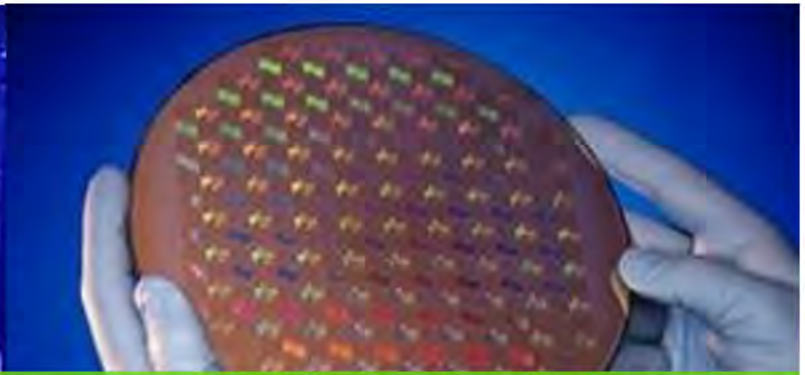
A **big universe**
of **very different substances**

SOLID	LIQUID	GAS
Polythylene	Ethyl Alcohol	Propane
$H(CH_2CH_2)_xH$	CH_3CH_2OH	$CH_3CH_2CH_3$

3M Specialty Fluids

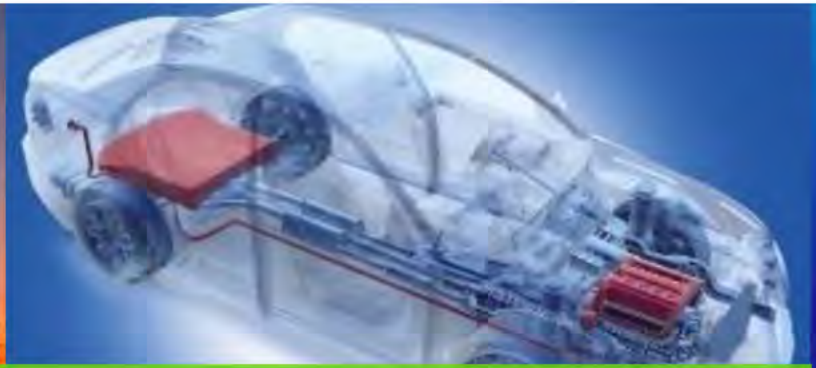
Protecting valuable assets from fire

Cooling data centers



Enabling semiconductor manufacturing

Reducing climate impact in the energy sector



Addressing thermal management applications in EVs

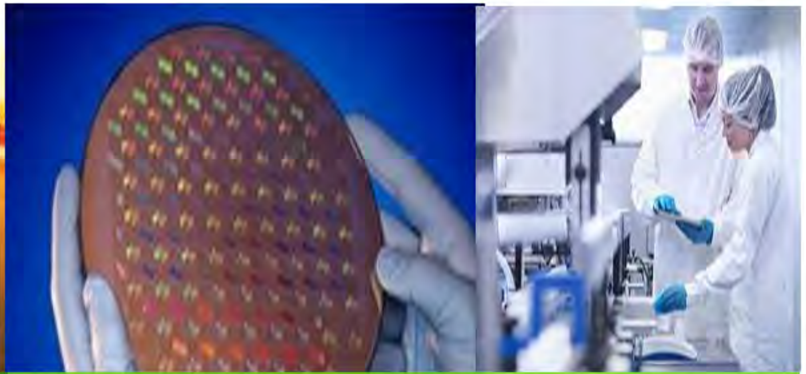
3M NOVEC™ ENGINEERED FLUIDS ARE OFTEN USED IN REPLACEMENT OF OZONE DEPLETING CHEMICALS, CHEMICALS WITH MUCH HIGHER GWP VALUES, HAZARDOUS CHEMICALS OR SUBSTANCES OF VERY HIGH CONCERN

3M Specialty Fluids exhibit important and unique performance characteristics owing to their chemistries and provide important value, often with performance that cannot be achieved with other solutions

3M Fluoropolymers

Corrosion protection & emission reduction in chemical & power plants

Power generation energy solutions



Enabling semiconductor and pharmaceutical manufacturing

Medical applications

Low emission transportation

- ✓ Highly stable high molecular weight materials.
- ✓ They have no bio-availability and no mobility in the environment.
- ✓ Indispensable in many applications with high societal value.

3M Fluoropolymers exhibit important and unique performance characteristics and provide important value, often with performance that cannot be achieved with other solutions.

***Perception**: PFAS can be easily substituted*

Reality: Many applications require PFAS' unique properties

Low emission transportation

Corrosion protection and emission reduction

Medical applications

Pharmaceutical manufacturing and products

Semiconductor manufacturing and electronics

Energy recovery and heat transfer
Data center cooling

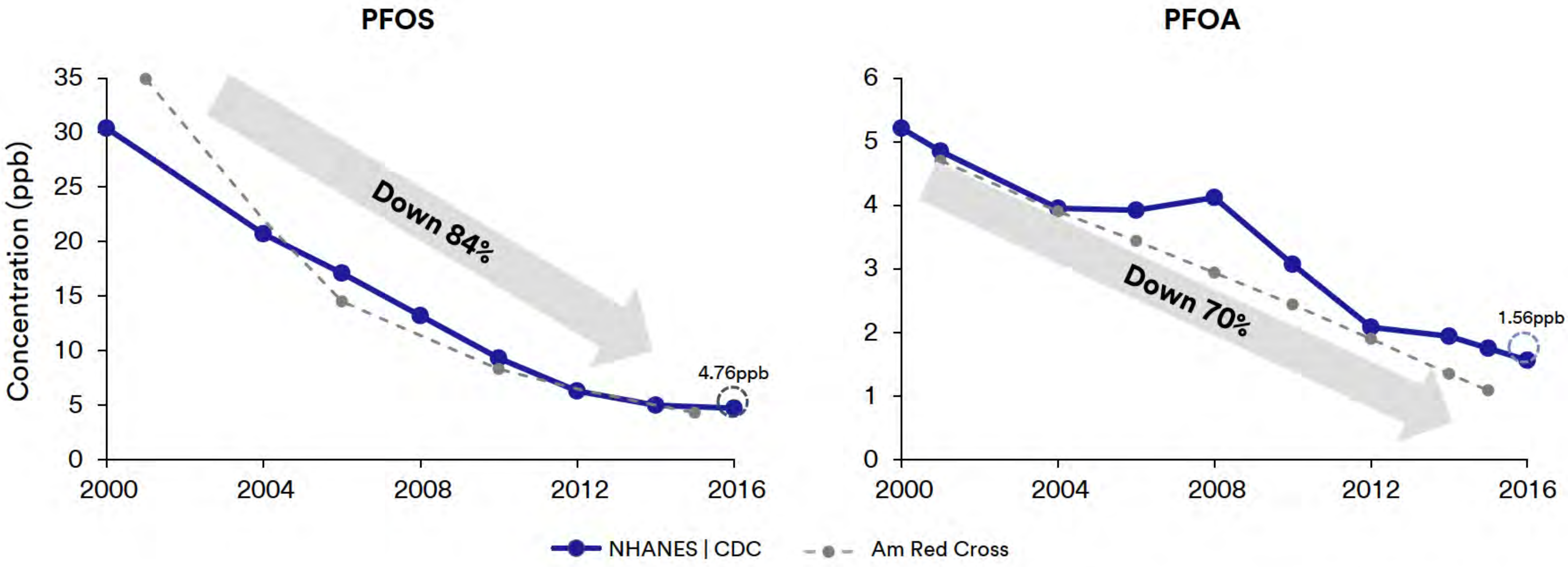
Fire suppression

3M

Health Science - Legacy Materials

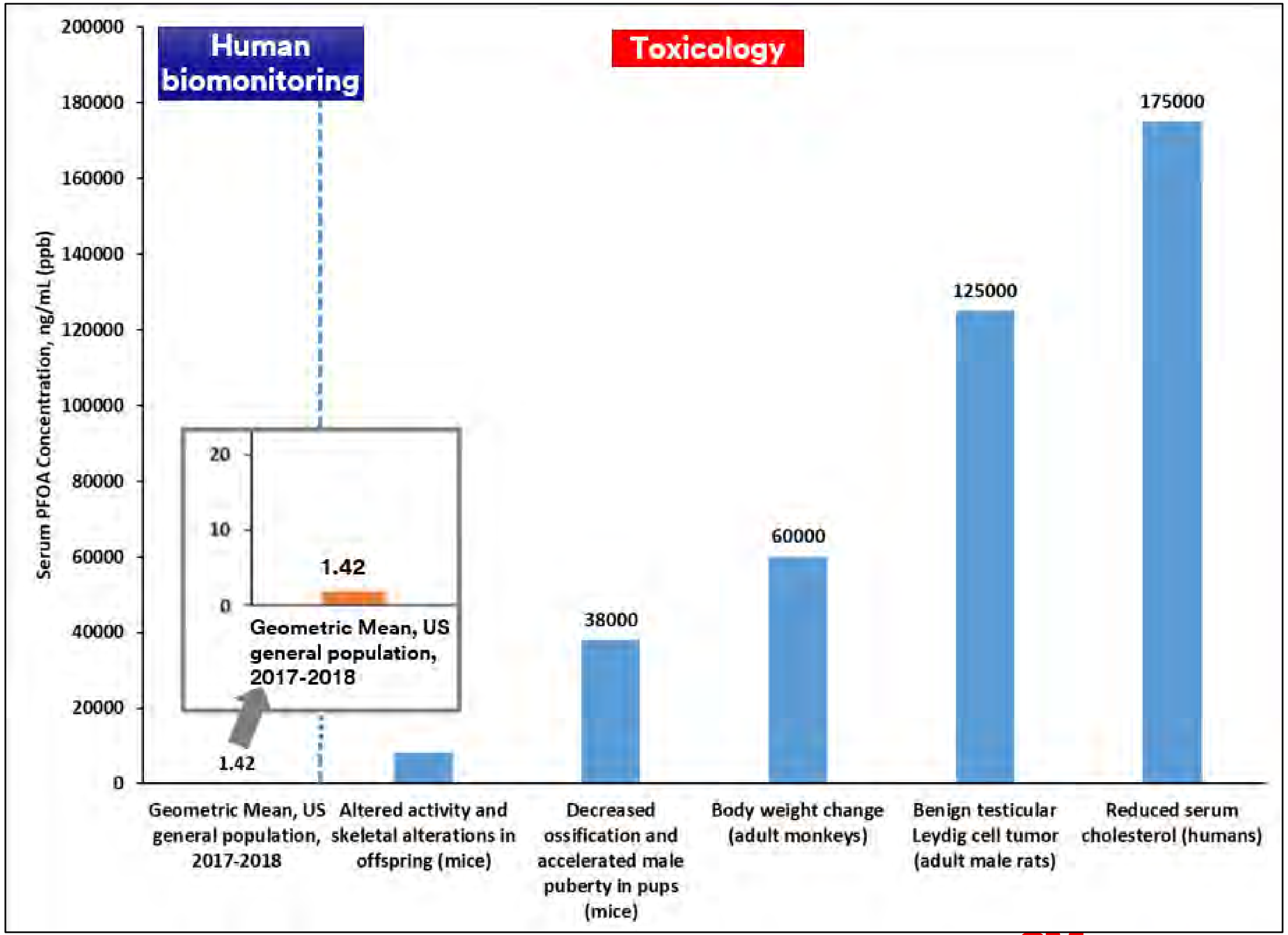
Perception: *PFOA and PFOS exposure is a growing problem*

Reality: PFOA and PFOS serum levels have been decreasing since 2000

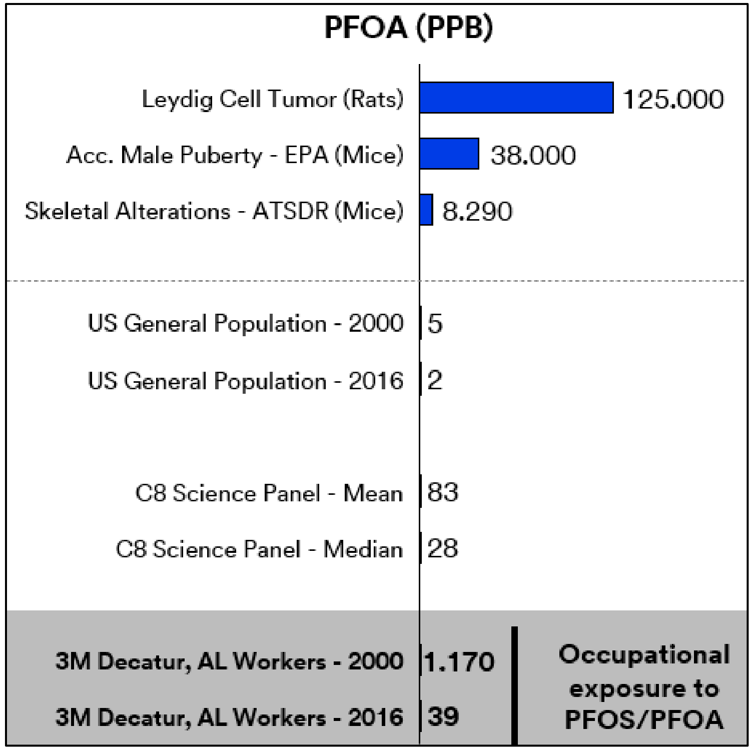


Source: Olsen et al. 2017 Environ Res 157 87-95; NHANES 2018

Perception: *PFOA & PFOS are highly toxic and an acute health threat*
Reality: Concentration and dosage matters



= health science research shows large safety margin



Public Health Agency Statements on Causality*

ATSDR Toxicological Profile "The available human studies have identified some potential targets of toxicity; however, **cause-and-effect relationships have not been established for any of the effects**, and the effects have not been consistently found in all studies"	Michigan PFAS Science Advisory Panel "[C]ausality between a PFAS chemical and a specific health outcome in humans **has not been established** in the current scientific literature"
Australian Expert Health Panel "[T]here is mostly limited or no evidence for any link with human disease from these observed differences. Importantly, **there is no current evidence that supports a large impact on a person's health as a result of high levels of PFAS exposure.**"	International Agency for Research on Cancer **Category 2b: Possible Carcinogen**: There is limited evidence in humans** and experimental animals for the carcinogenicity of perfluorooctanoic acid (PFOA)

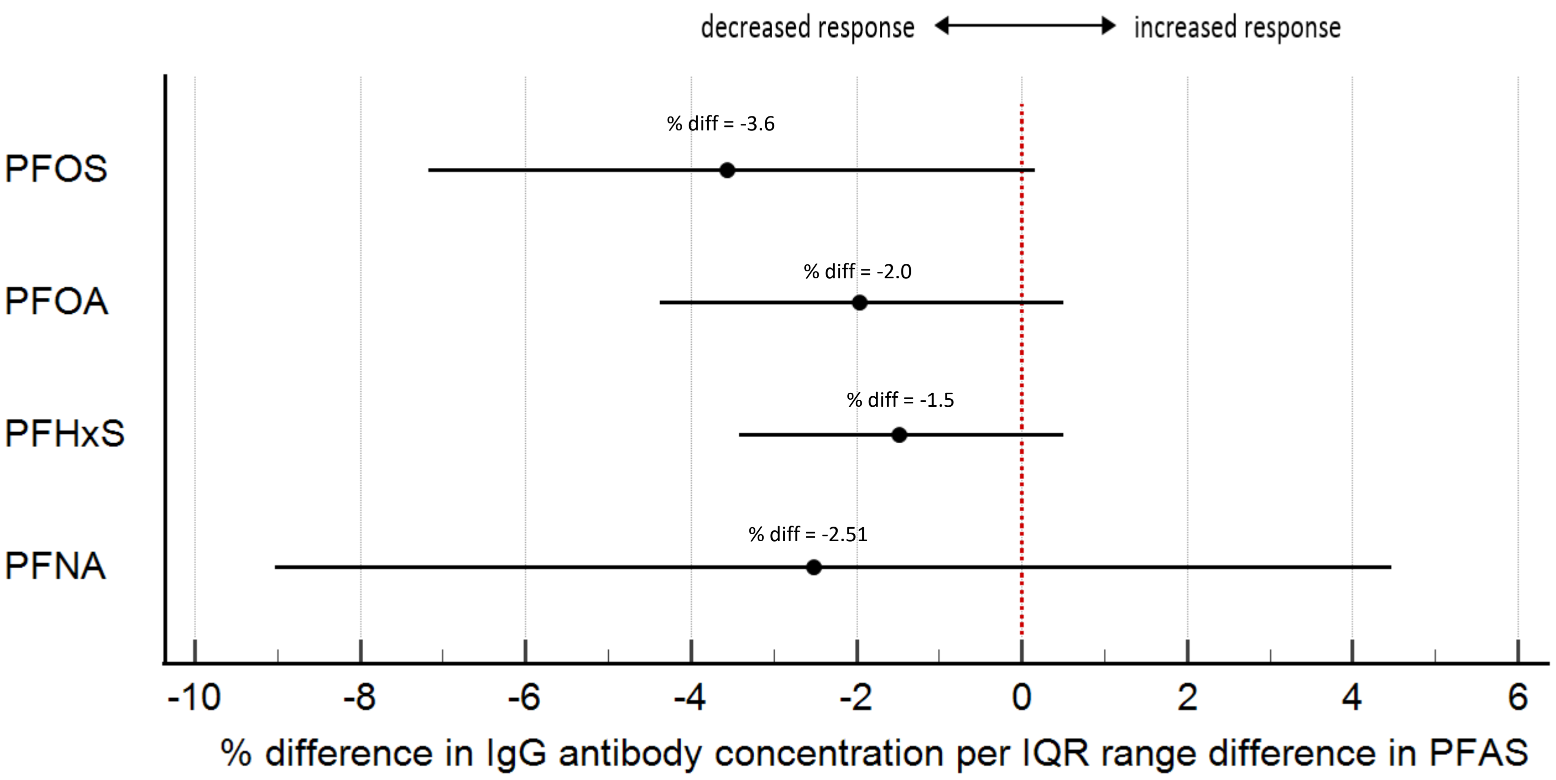
Additional research continues with current focus on immunotoxicology

*PFAS chemistries evaluated by each agency/panel varied

**Also in this category: pickled vegetables, aloe vera extract, and cell phone radiation

Health Science – Immunoresponse

A new study on COVID-19 shows a small reduction in antibody response, but results not statistically significant; no association with COVID-19 disease



Models adjusted for age, gender, race, BMI, site, smoking, immunocompromising conditions, corticosteroid use, time since antigenic stimulus, and antigenic stimulus group.

Note: PFOS IQR = 14.6; PFOA IQR = 3.6; PFHxS IQR = 5.2; PFNA IQR = 0.3 ng/mL

Porter, et.al, "Anti-body response to COVID-19 vaccines among workers with a wide range of exposure to per- and polyfluoroalkyl substances", Environmental International, 169 (2022), 107537

- Wide range of PFAS concentrations in blood measured in diverse population (n=415)
- Models fully adjusted for age, race, gender, etc..
- Small inverse effect seen with IgG antibody concentration per increase in PFOS
- Confidence interval intersects zero indicating results not statistically significant
- Similar results seen for neutralizing antibody
- Case control study with 3M worker show no association between PFOS, PFOA, PFHxS, PFNA (and other PFAS compounds) and COVID-19

Health Science –
Modern Fluorochemistries

What about the current (short-chain) PFAS?

Human biomonitoring: PFBS is not detected in general population

Serum perfluorobutane sulfonic acid (PFBS): 2003-2014

	Survey years	Geometric mean	50th percentile	75th percentile	90th percentile	95th percentile	Sample size
				95% conf. interval			
Total	03-04	*	<LOD*	<LOD	<LOD	<LOD	2,094
	05-06	*	<LOD	<LOD	<LOD	.100 (<LOD-.200)	2,120
	07-08	*	<LOD	<LOD	<LOD	<LOD	2,100
	09-10	*	<LOD	<LOD	<LOD	<LOD	2,233
	11-12	*	<LOD	<LOD	<LOD	<LOD	1,904
	13-14	*	<LOD	<LOD	<LOD	<LOD	2,168
	15-16	Not measured					
	17-18	Not measured					

*Level of Detection (LOD)

CDC NHANES Biomonitoring Data for PFBS in the US General Population
(https://www.cdc.gov/exposurereport/pdf/FourthReport.pdf)

Biomonitoring campaign Zwijndrecht citizens (2021)

796 people participated

Tabel 2 Concentratie van PFAS in serum bij 796 deelnemers in de buurt van 3M in Zwijndrecht

PFAS	% deelnemers met meetbare waarde	Mediaan (µg/L)	90e percentiel (µg/L)
$PFOS_{lineair+vertakt}$	100%	20,4	79,6
$PFOS_{lineair}$	100%	5,40	50,5
$PFOA_{lineair+vertakt}$	99,4%	1,44	2,95
$PFOA_{lineair}$	99,2%	1,39	2,85
$PFHxS_{lineair+vertakt}$	99,1%	1,47	4,75
$PFHxS_{lineair}$	99,0%	1,46	4,66
PFNA	90,0%	0,43	0,96
PFDA	47,1%	-	0,48
PFHpS	30,0%	-	0,61
PFUnA	12,8%	-	0,22
PFHpA	10,6%	-	0,20
PFBA	4,5%	-	-
PFBS	2,6%	-	-
PFDoA	1,1%	-	-
PFHxA	0,3%	-	-
PFPeA	0,0%	-	-

EFSA Opinion on PFAS (2020)

EFSA Opinion (2020)

TWI established by EFSA is highly questionable from a scientific point of view.

- TWI of 4.4 ng per kg body weight for four PFAS (PFOA, PFOS, PFHxS, and PFNA) was derived solely based on observations from a small cross-sectional epidemiological study (Abraham et al.).
- This study is showing a statistical association of PFOA with reduced antibody levels to three vaccine antigens. No significant reduction in these antibody levels were observed for neither PFOS nor PFNA, and PFHxS. There was no increased risk of infections reported.
- In their analyses EFSA grouped the four PFAS to arrive at their overall association with reduced antibody levels. Reference values derived from them are therefore highly questionable.
- Considering that EFSA itself has acknowledged that "a clear mode of action of immunotoxicity by PFOS and PFOA has not been established", it remains uncertain how these data points can serve as a foundation for a new TWI.

Archives of Toxicology
https://doi.org/10.1007/s00204-022-03303-4

REVIEW ARTICLE

Check for updates

Immunomodulation and exposure to per- and polyfluoroalkyl substances: an overview of the current evidence from animal and human studies

Evangelia Antoniou[1] · Thomas Colnot[2] · Maurice Zeegers[1] · Wolfgang Dekant[3]

Received: 6 April 2022 / Accepted: 13 April 2022

Abstract
Per- and polyfluoroalkyl substances (PFAS) have been widely used and represent a class of environmental persistent chemicals. An association of a reduction of vaccination efficacy with PFAS serum levels in humans was used by the European Food Safety Authority as a key effect for PFAS risk assessment. The data support for using this association is reviewed by a critical analysis of the respective human epidemiology and the available animal studies on the immunomodulation of PFAS. Based on an analysis of the available human epidemiology, the overall level of evidence regarding associations between PFAS serum levels and reduced antibody response remains weak. Absence of an association between an increase in clinical infections and PFAS serum levels and the limited understanding of the importance of antibody levels as an isolated data point further support this conclusion. Animal toxicity studies with PFAS focusing on immunomodulation also provide only limited support for immunomodulation as an important endpoint in PFAS toxicity. While immunomodulation is observed after PFAS administration, generally at blood concentrations several orders of magnitude above those seen in environmentally exposed humans, the relevance of these observation is hampered by the high doses required to influence immune endpoints, the limited number of endpoints assessed, and inconsistent results. The limitations of the current database on associations of human PFAS exposures outlined here indicate that more evidence is required to select immunomodulation as a critical endpoint for human PFAS risk assessment.

Keywords Per- and poly-fluorinated aliphatic substances · Immunomodulation · Human studies · Animal toxicity

EFSA
July 2020

- Based on a small cross-sectional study of only 101 children in Germany (Abraham et al. 2020), in which PFOA was associated with ↓ antibody levels* to Hib, tetanus, and diphtheria (no association found for PFOS, PFHxS, or PFNA)
- EFSA derived TWI for four PFAS combined
- No mode of action identified

* There was no association with other components of immune system and there were no increased infections

SCIENTIFIC OPINION

EFSA Journal

ADOPTED: 9 July 2020

doi: 10.2903/j.efsa.2020.6223

Risk to human health related to the presence of perfluoroalkyl substances in food

Epidemiological studies published since the publication of the previous EFSA CONTAM Panel Opinion on PFOS and PFOA provide further support for the conclusion that PFOS and PFOA are associated with reduced antibody response to vaccination, observed in several studies. The evidence for other PFASs is weaker, related to the mixture of PFASs in blood, the lower concentrations compared to PFOS and PFOA, and the small number of studies. Some of the studies suggest that serum levels of PFOS and PFOA are associated with increased propensity for infection. As for PFOS and PFOA, epidemiological studies provide insufficient evidence to conclude on associations between exposure to PFASs and asthma and allergies.

Grandjean et al.
December 2020

- Reported blood PFBA level associated with greater severity of Covid-19 prognosis
- Speculated that might be due to higher PFBA levels in lungs (based on study by Perez et al. 2013)
- Eight other PFAS including PFOA, PFOS, PFHxS, and PFNA were also measured but no association reported

PLOS ONE

https://doi.org/10.1371/journal.pone.0244815

RESEARCH ARTICLE

Severity of COVID-19 at elevated exposure to perfluorinated alkylates

Philippe Grandjean[1,2]*, Clara Amalie Gade Timmermann[2], Marie Kruse[2], Flemming Nielsen[2], Pernille Just Vinholt[3], Lasse Boding[4], Carsten Heilmann[5], Kåre Mølbak[4,6]

Abraham et al.
August 2021

- BfR scientists conducted its own study using tissue bank samples
- Reported "*a high accumulation of PFBA is unlikely to occur in human lungs*"
- Concluded that PFBA is "*unsuitable as possible explanation of a higher severity of COVID-19 due to higher PFAS/PFBA exposure.*"

International Journal of Hygiene and Environmental Health 237 (2021) 113830

Contents lists available at ScienceDirect

ELSEVIER

International Journal of Hygiene and Environmental Health

journal homepage: www.elsevier.com/locate/ijheh

Perfluorobutanoic acid (PFBA): No high-level accumulation in human lung and kidney tissue

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Impact of the new EFSA values

Proportionality and impracticability should be considered when applying new EFSA values

- Lack of available analytical methods at such low levels for soil, water and foodstuff will make it infeasible to detect and consequently implement/enforce new guidance values if directly applying the proposed TWI.
- Further stringent remediation targets not based on rigorous science will create disproportionate treatment costs, treatment options for groundwater a/o disposal options for excavated soils may diminish.
- Lower guidance values for agricultural products or drinking water would require more testing. Proving the safety of any food product or drinking water might become challenging.

Summary & Recommendations from 3M

Impact of the EU approach on PFAS <u>as currently envisaged</u> could be detrimental to European economy & citizens

- Specialty fluids & fluoropolymers are a necessity, not a choice. The current design of PFAS regulation (= "ban all PFAS") will not allow for manufacturing of semiconductors, cars, planes, medical devices, and other critical applications, even if some 'essential uses' are allowed.
- The ability of mankind to tackle climate change with technological solutions is at stake if those PFASs are banned.
- Safety and security provided for military / defense applications cannot be secured if manufacturing and supply of specialty fluids & fluoropolymers is not ensured.
- Fluoropolymers are inherently safe, non-mobile, non-bio accumulative and non-toxic.
- 3M is taking action to effectively reduce manufacturing emissions & remediate.
- We are working with our customers and industry partners to control emissions effectively throughout life-cycle (closed-loop systems, recovery & recycling).

- **Keeping manufacturing & supply chain of specialty fluids and fluoropolymers in Europe will be crucial for Europe's strategic autonomy.**

3M recommendations

- **PFAS is a very broad and diverse group of substances with different properties.** Regulating and restricting **PFAS as a group would have little scientific basis** and would be disproportionate.
- EU Commission needs to **ensure that a differentiated approach is adopted between various PFAS,** based on evidence as to which PFAS are posing an unacceptable risk to the environment and health. To do otherwise risks phasing out chemicals which are set to play a critical role in helping industry to innovate towards a decarbonized and circular economy.

  Need alternative grouping approach – decision tree based on risk: from health & environmental risk profile to how they are used (emissions controlled, safe use, critical for society…)

- Many products need to be durable and perform over time under demanding, sometimes extreme, conditions. Specialty chemicals like **PFAS are persistent for purpose.** A loss in any of those key areas may lead to additional maintenance or shorter lifespans of products (or increase in volume of materials need).

  Need to be proportionate and consider the benefits of persistence and durability in the context of the circular economy and other EU Green Deal objectives

End