

A vision for **safe and sustainable** food contact materials

Jane Muncke



Food
Packaging
Forum





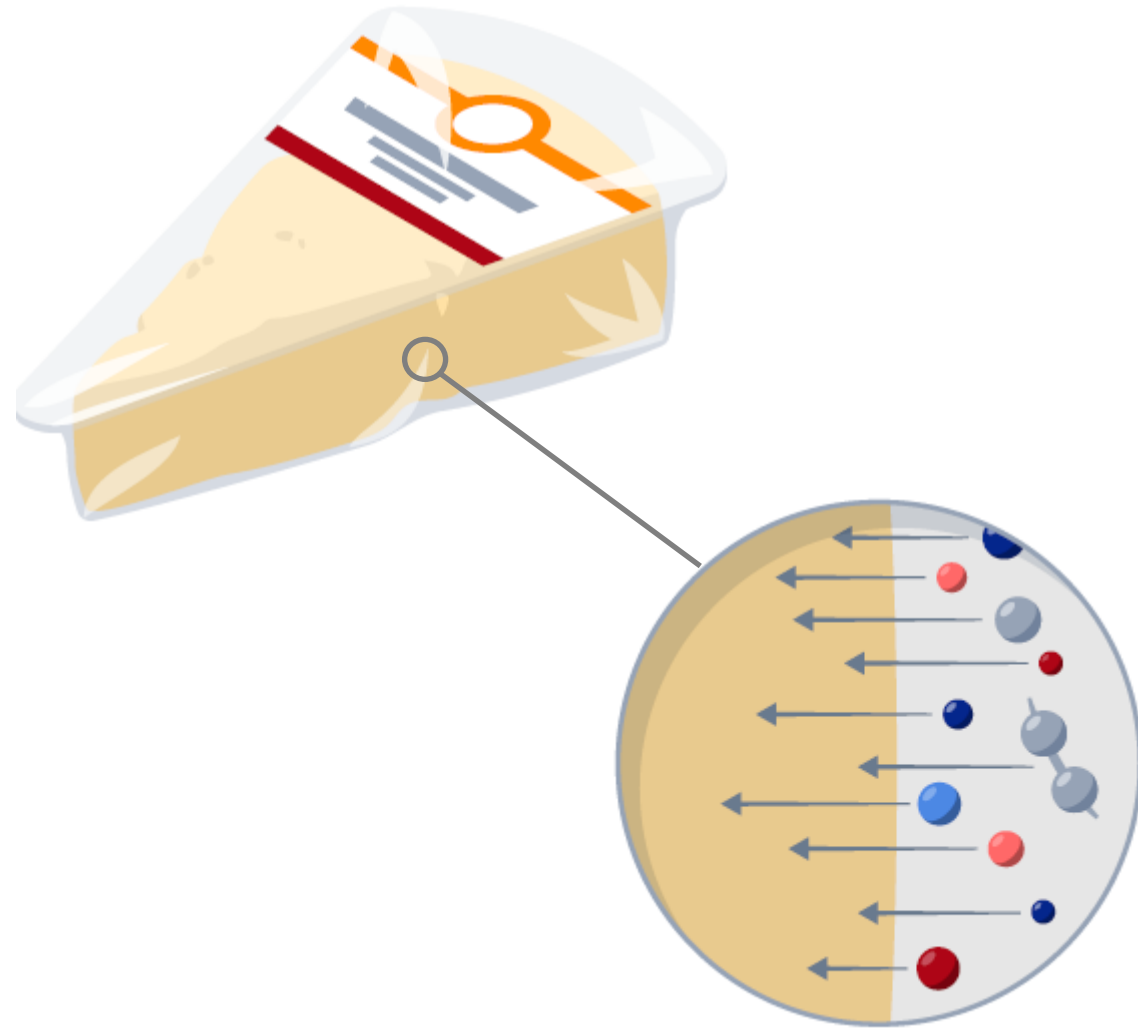


Chemicals **migrate** from food packaging into foodstuffs





chemical migration





Legal definition of FCM safety in the EU

Regulation (EC) No 1935/2004, Art. 3.1.(a)

“Materials and articles, [...], shall be manufactured [...] so that, under normal or foreseeable conditions of use, they do not transfer their constituents to food in quantities which could endanger human health”

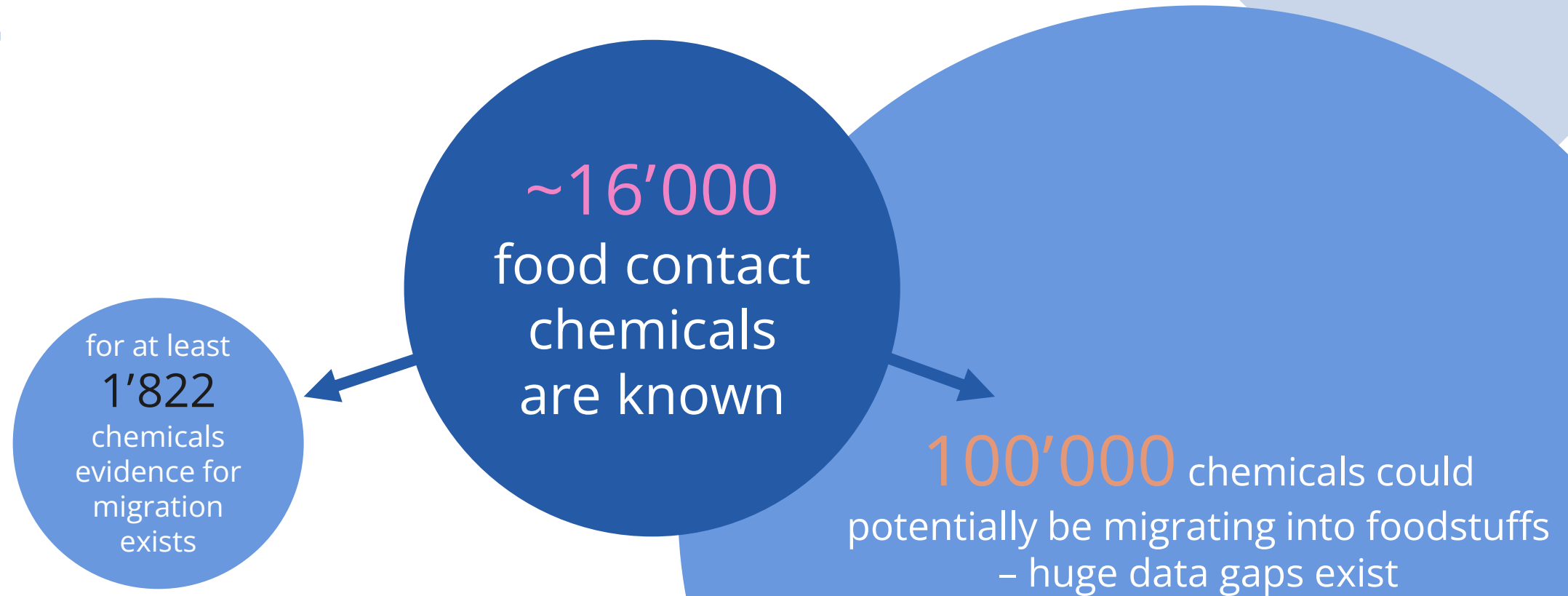


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Many *food contact chemicals* migrate into foodstuffs





In perspective: Food Contact Materials are an underestimated source of chemical food contamination



	PESTICIDES	FOOD CONTACT MATERIALS (FCM)
Number of Substances	~1,500	Possibly 100,000
Level of food contamination	µg/kg (ppb)	mg/kg (ppm)
Toxicological evaluation	yes	mostly no

Source: presentation by Dr. Gregor McCombie, Official Food Control Authority Zurich, January 26, 2016, [EU Parliament Workshop](#).



2017

Commentary

<https://doi.org/10.1289/EHP644>

Scientific Challenges in the Risk Assessment of Food Contact Materials

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Chemicals **contribute** to chronic diseases.




COMMENTARY

Open Access

Impacts of food contact chemicals on human health: a consensus statement

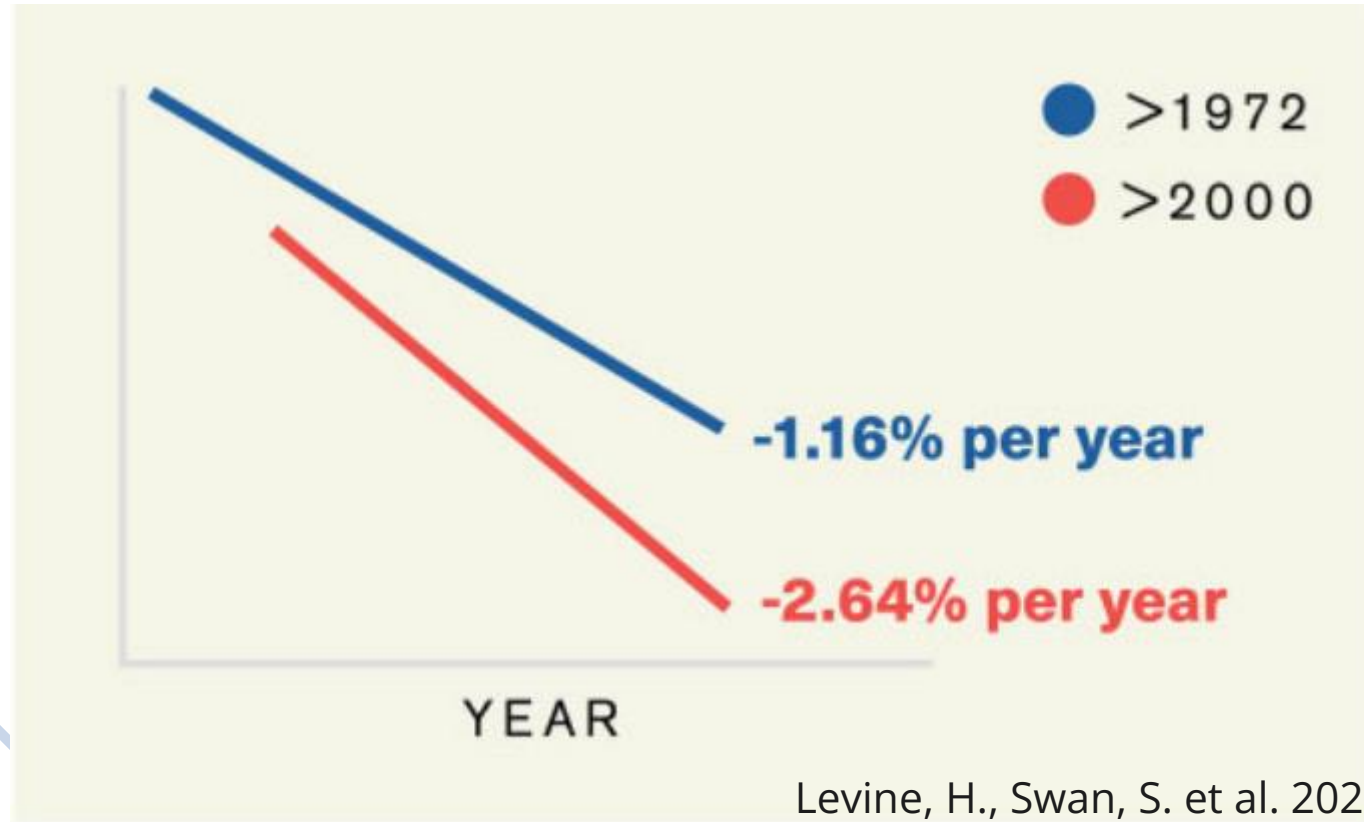


Jane Muncke^{1*} , Anna-Maria Andersson², Thomas Backhaus³, Justin M. Boucher⁴, Bethanie Carney Almroth³, Arturo Castillo Castillo⁵, Jonathan Chevrier⁶, Barbara A. Demeneix⁷, Jorge A. Emmanuel⁸, Jean-Baptiste Fini⁷, David Gee⁹, Birgit Geueke¹, Ksenia Groh¹, Jerrold J. Heindel¹⁰, Jane Houlihan¹¹, Christopher D. Kassotis¹², Carol F. Kwiatkowski¹³, Lisa Y. Lefferts¹⁴, Maricel V. Maffini¹⁵, Olwenn V. Martin¹⁶, John Peterson Myers^{17,18}, Angel Nadal¹⁹, Cristina Nerin²⁰, Katherine E. Pelch¹³, Seth Rojello Fernández²¹, Robert M. Sargis²², Ana M. Soto²³, Leonardo Trasande²⁴, Laura N. Vandenberg²⁵, Martin Wagner²⁶, Changqing Wu²⁷, R. Thomas Zoeller²⁸ and Martin Scheringer^{4,29}

Source: <https://ehjournal.biomedcentral.com/articles/10.1186/s12940-020-0572-5>

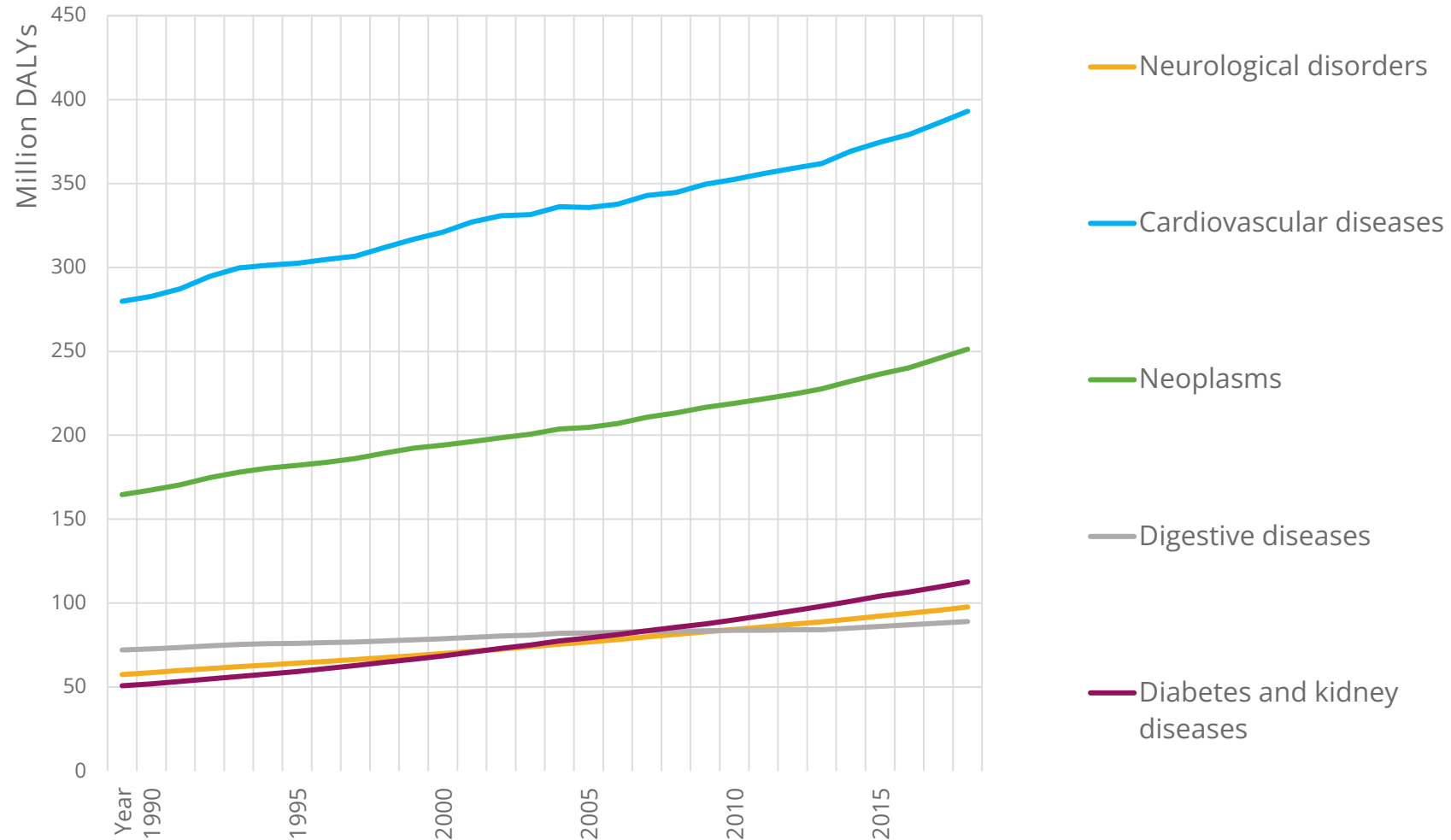


Sperm count is declining at an accelerated pace globally





Chronic disease burden is increasing globally



Disability-Adjusted Life Years (DALYs).
Data: Global Burden of Disease 2021.



ELSEVIER

Research Paper

Implementing the EU Chemicals Strategy for Sustainability: The case of food contact chemicals of concern

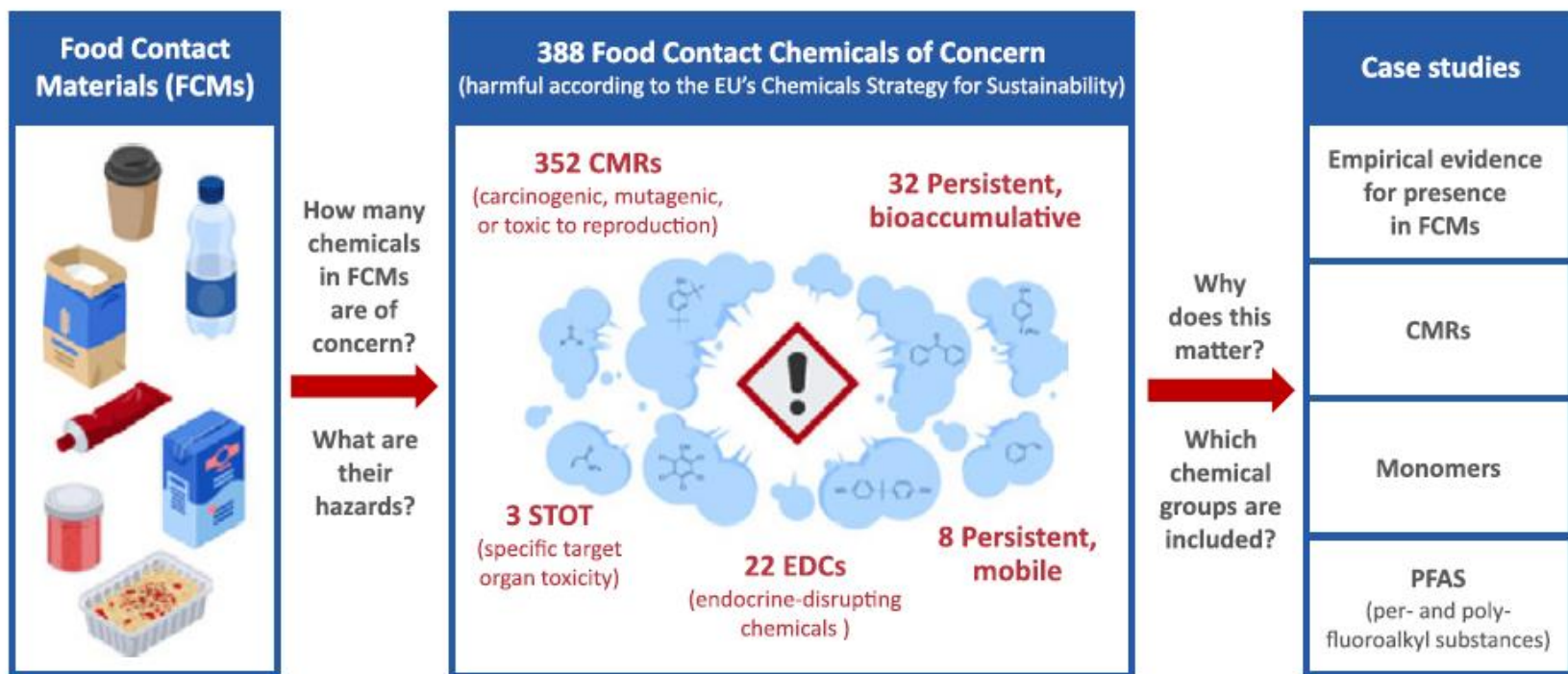
Lisa Zimmermann^{a,*}, Martin Scheringer^b, Birgit Geueke^a, Justin M. Boucher^a, Lindsey V. Parkinson^a, Ksenia J. Groh^c, Jane Muncke^a

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At least 127 food contact chemicals that are legally used in food contact materials in the EU are of concern AND have empirical evidence for migration from food contact articles.





To prevent illness, test **all food contact chemicals** for their impact on increasingly prevalent chronic diseases.



2023



Contents lists available at [ScienceDirect](#)

Environment International

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



Full length article

A vision for safer food contact materials: Public health concerns as drivers for improved testing

Jane Muncke^{a,*}, Anna-Maria Andersson^b, Thomas Backhaus^c, Scott M. Belcher^d, Justin M. Boucher^a, Bethanie Carney Almroth^c, Terrence J. Collins^e, Birgit Geueke^a, Ksenia J. Groh^f, Jerrold J. Heindel^g, Frank A. von Hippel^h, Juliette Leglerⁱ, Maricel V. Maffini^j, Olwenn V. Martin^k, John Peterson Myers^{e,l}, Angel Nadal^m, Cristina Nerinⁿ, Ana M. Soto^{o,p}, Leonardo Trasande^q, Laura N. Vandenberg^r, Martin Wagner^s, Lisa Zimmermann^a, R. Thomas Zoeller^r, Martin Scheringer^{t,u,*}

<https://doi.org/10.1016/j.envint.2023.108161>



Testing the safety of food contact articles: STATUS QUO





Six Clusters of Disease (SCOD)



Cancers

- Breast cancer
- Prostate cancer
- Kidney cancer



Cardiovascular diseases

- Hypertension
- Atherosclerosis
- Myocardial infarction



Reproductive disorders

- Male infertility
- Female infertility



Brain-related disorders

- Hypothyroidism
- Abnormal neurodevelopment



Immunological disorders

- Immunosuppression
- Asthma
- Allergies



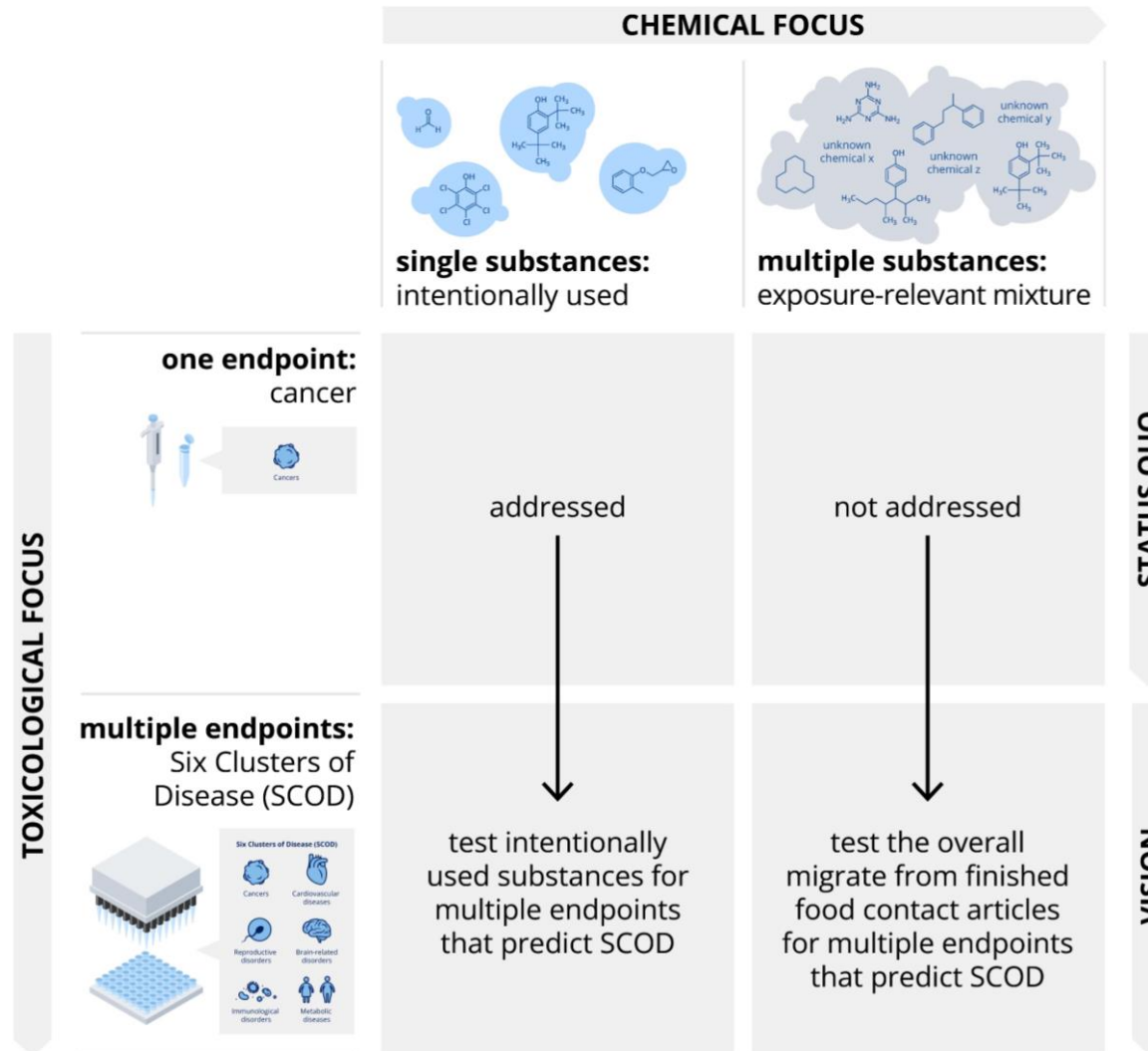
Metabolic diseases

- Diabetes type 1/2
- Obesity
- Non-alcoholic fatty liver disease

Muncke et al. 2023. Env. Int. <https://doi.org/10.1016/j.envint.2023.108161>

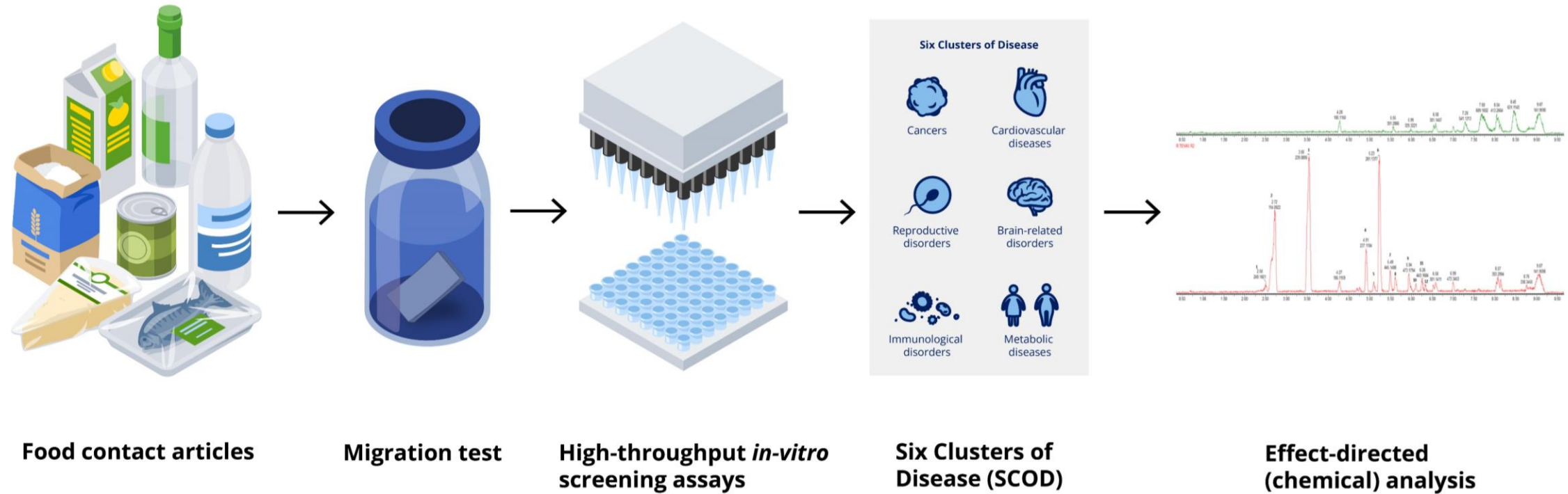


Safe food contact articles: the FPF vision





Fully safe food contact materials and articles are properly tested





Different approaches to identifying chemical hazard

Toxicology

- Does a chemical cause cancer?
- *in vivo* testing (animals)
- observational
- not at molecular level
- high cost, long time
- ethical considerations
- relatively good scientific certainty (?)

Adverse Outcome Pathway

- How does a chemical cause breast cancer?
- What is the molecular initiating event for breast cancer?
- (linear) cause-effect relationship needs to be established
- highly challenging to develop
- when available: highly useful for development of *in vitro* testing
- cost efficient, fast
- relatively good scientific certainty (?)

Key Characteristics

- Does a chemical have the key characteristics of carcinogens?
- *in vitro* assays to test chemical for these molecular-level properties of interacting with biological molecular targets
- (soon) available for all of the SCOD
- highly useful for development of *in vitro* testing
- cost efficient, fast
- relatively good scientific certainty (?)



Table 1. Key characteristics of carcinogens.

Characteristic	Examples of relevant evidence
1. Is electrophilic or can be metabolically activated	Parent compound or metabolite with an electrophilic structure (e.g., epoxide, quinone), formation of DNA and protein adducts
2. Is genotoxic	DNA damage (DNA strand breaks, DNA–protein cross-links, unscheduled DNA synthesis), intercalation, gene mutations, cytogenetic changes (e.g., chromosome aberrations, micronuclei)
3. Alters DNA repair or causes genomic instability	Alterations of DNA replication or repair (e.g., topoisomerase II, base-excision or double-strand break repair)
4. Induces epigenetic alterations	DNA methylation, histone modification, microRNA expression
5. Induces oxidative stress	Oxygen radicals, oxidative stress, oxidative damage to macromolecules (e.g., DNA, lipids)
6. Induces chronic inflammation	Elevated white blood cells, myeloperoxidase activity, altered cytokine and/or chemokine production
7. Is immunosuppressive	Decreased immunosurveillance, immune system dysfunction
8. Modulates receptor-mediated effects	Receptor in/activation (e.g., ER, PPAR, AhR) or modulation of endogenous ligands (including hormones)
9. Causes immortalization	Inhibition of senescence, cell transformation
10. Alters cell proliferation, cell death or nutrient supply	Increased proliferation, decreased apoptosis, changes in growth factors, energetics and signaling pathways related to cellular replication or cell cycle control, angiogenesis

Abbreviations: AhR, aryl hydrocarbon receptor; ER, estrogen receptor; PPAR, peroxisome proliferator–activated receptor. Any of the 10 characteristics in this table could interact with any other (e.g., oxidative stress, DNA damage, and chronic inflammation), which when combined provides stronger evidence for a cancer mechanism than would oxidative stress alone.



Smith MT. et al. 2016. Key Characteristics of Carcinogens as a Basis for Organizing Data on Mechanisms of Carcinogenesis. *Env. Health Persp.* <http://dx.doi.org/10.1289/ehp.1509912>



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low levels \neq safe levels



If it's not safe,
it's not sustainable.



recyclable \neq sustainable



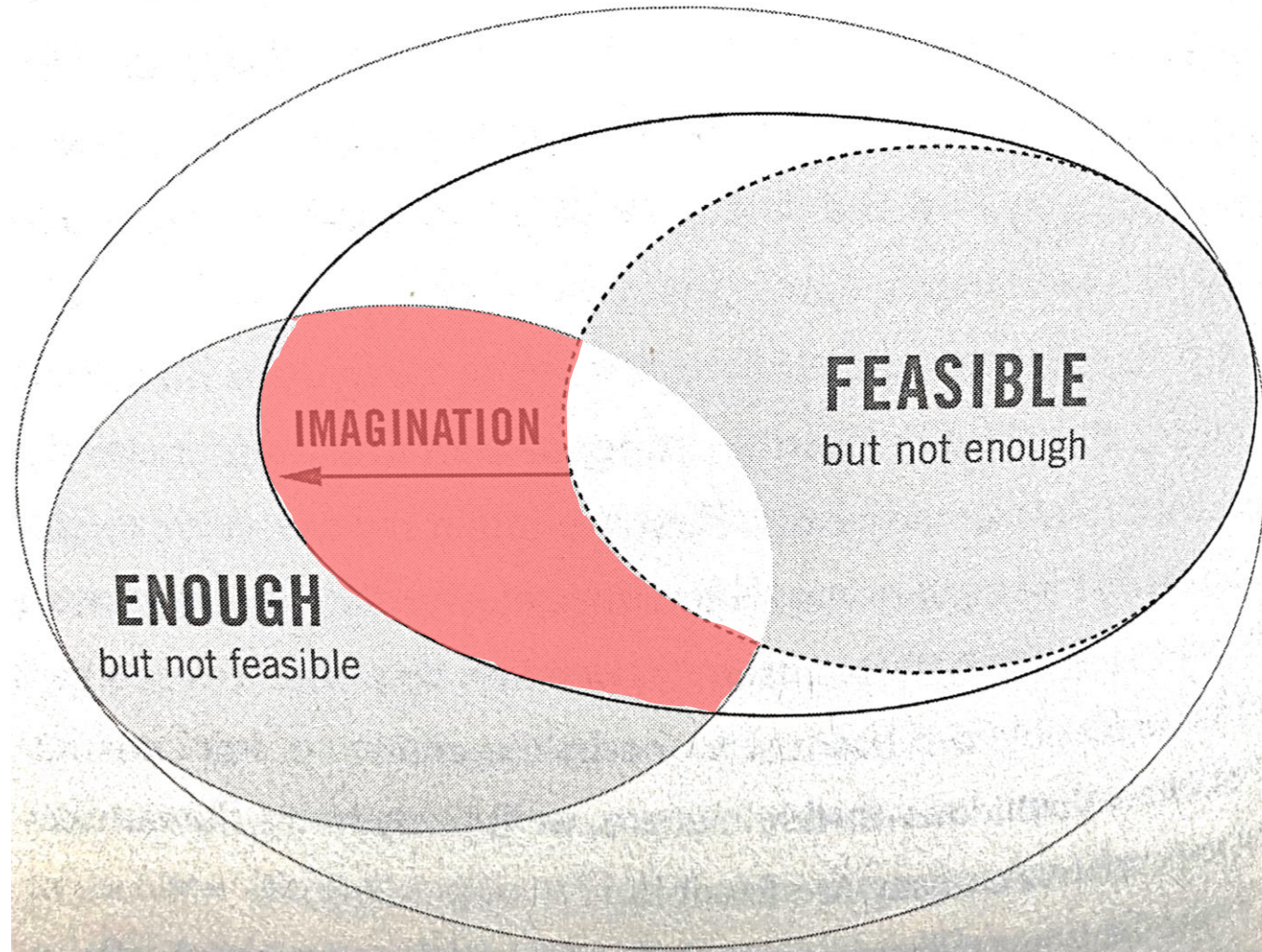
What is **fully** sustainable food packaging?

- enables **circular and fair business models** that deliver nutritious, safe, and culturally appropriate foodstuffs to people
- no **adverse impacts** that destabilize the planet's ecosystems in the long term **across its entire life cycle**
- it **internalizes all (external) costs** to people and the planet

Source: Cabane, E., Suter, F., Zimmermann, L., Boucher, J., Muncke, J. et al. under preparation. "What is sustainable food packaging, and how can it be quantified?"



Collaborate, know the science and *be creative!*



Source: Thomas Homer-Dixon, 2020. Commanding Hope. P. 228



THANK YOU

