



# Chemicals in plastic food packaging



**Ksenia Groh**  
*Food Packaging Forum*

**CHE webinar**  
**3 December 2018**



Food  
Packaging  
Forum

# Food Packaging Forum (FPF) foundation



Scientific communication



Food contact materials/chemicals, migration, health effects



Founded in 2012 in Zürich



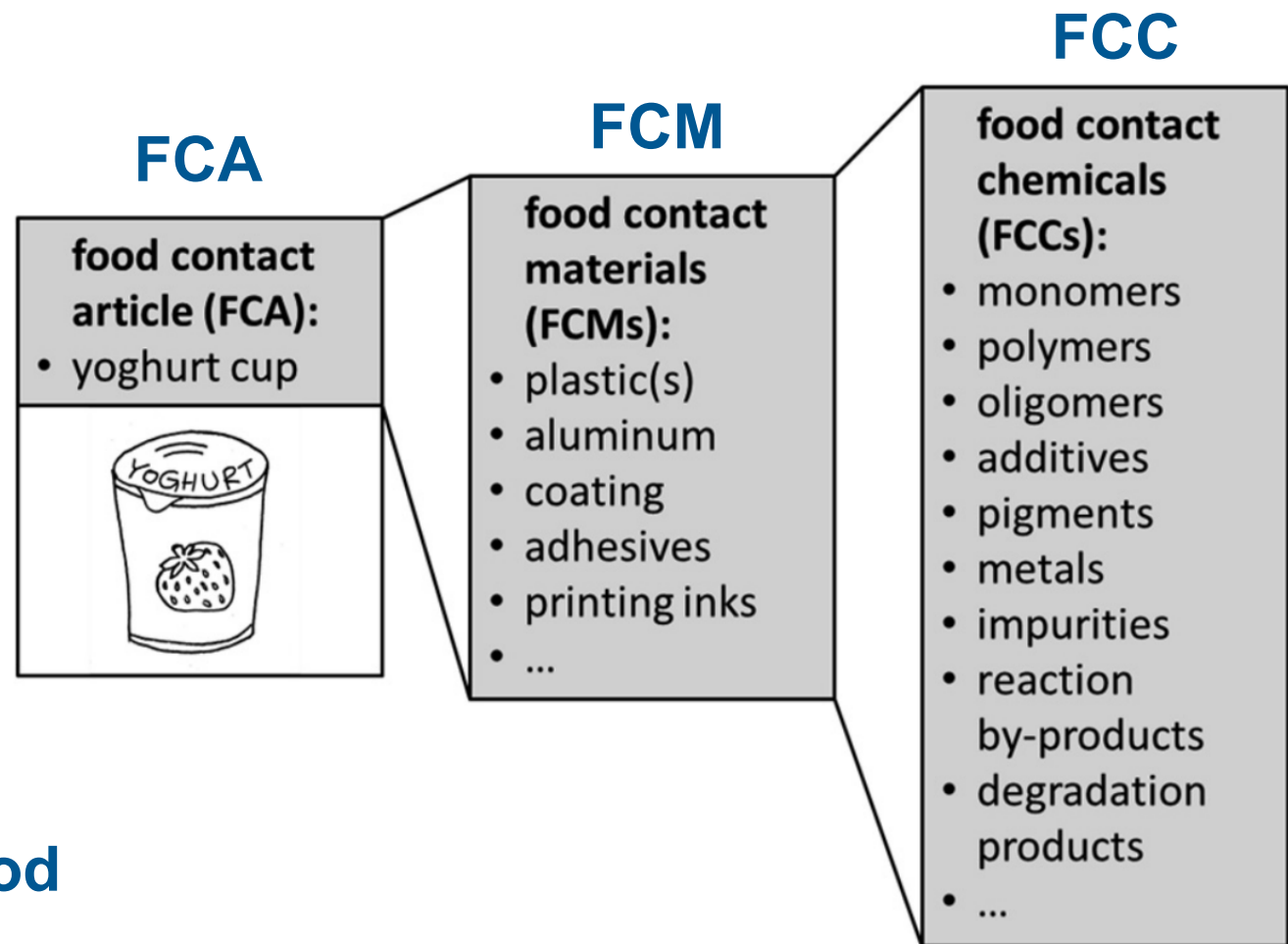
Non-profit, funded by unconditional donations



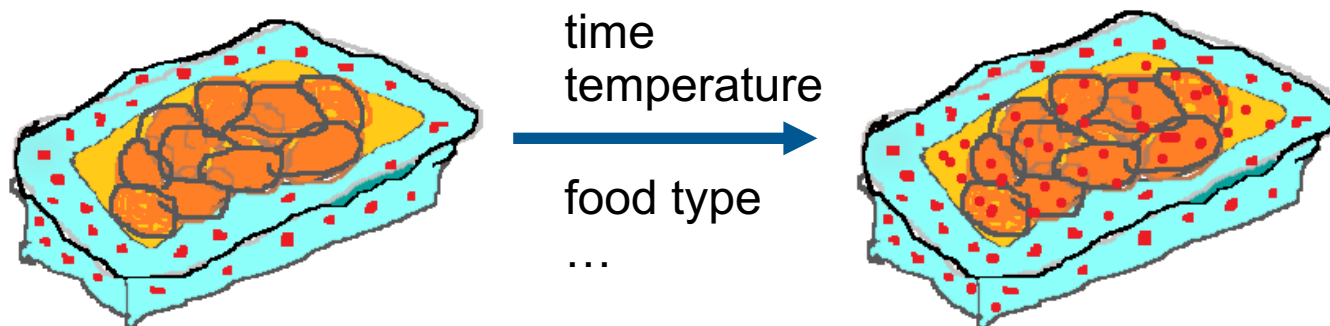
Scientists, industry experts, regulators, communicators



# Key concepts

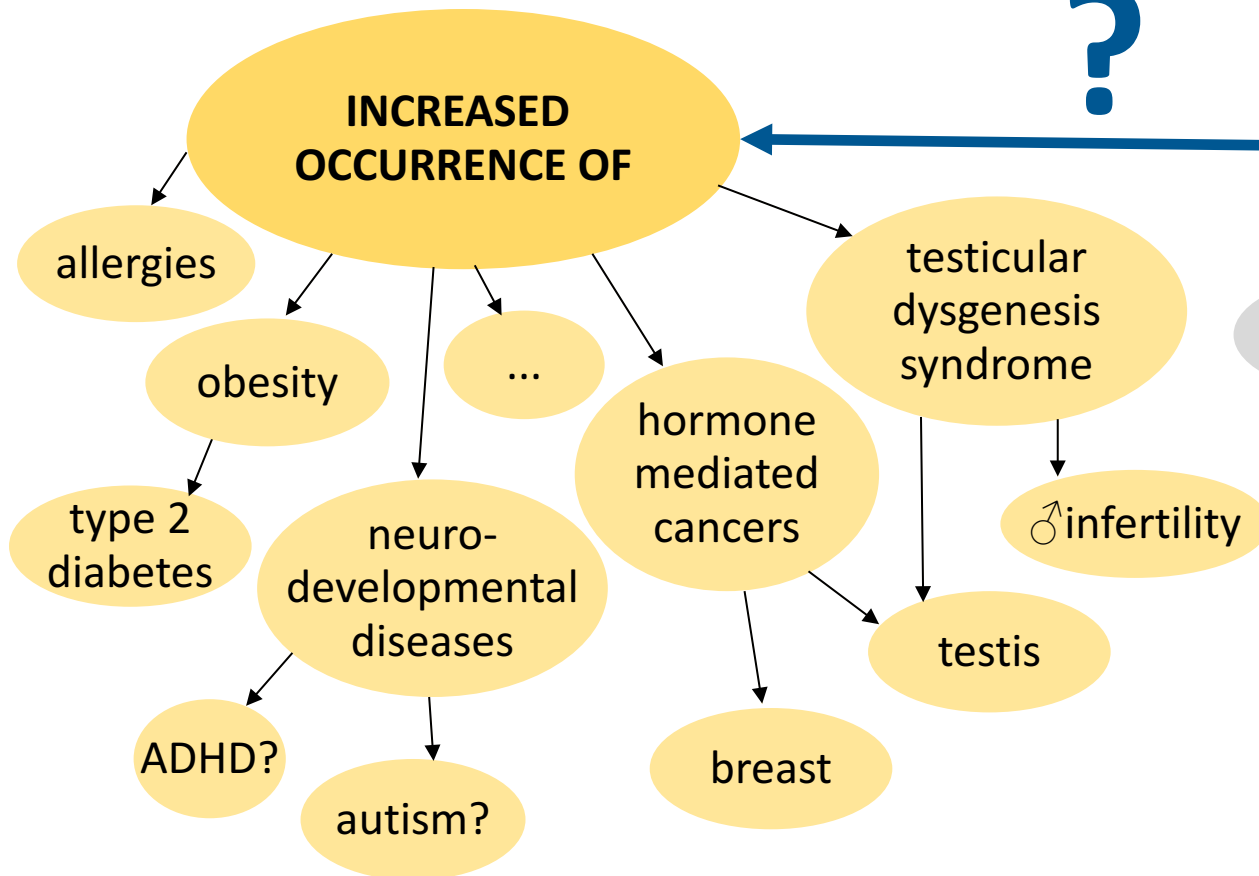


## Migration into food

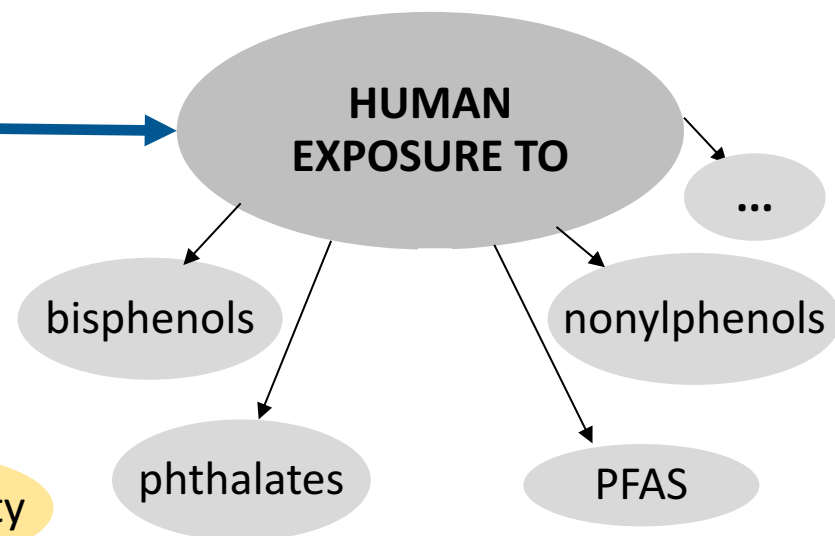


# FCC's contribution to chronic diseases?

## EPIDEMIOLOGY



## BIOMONITORING

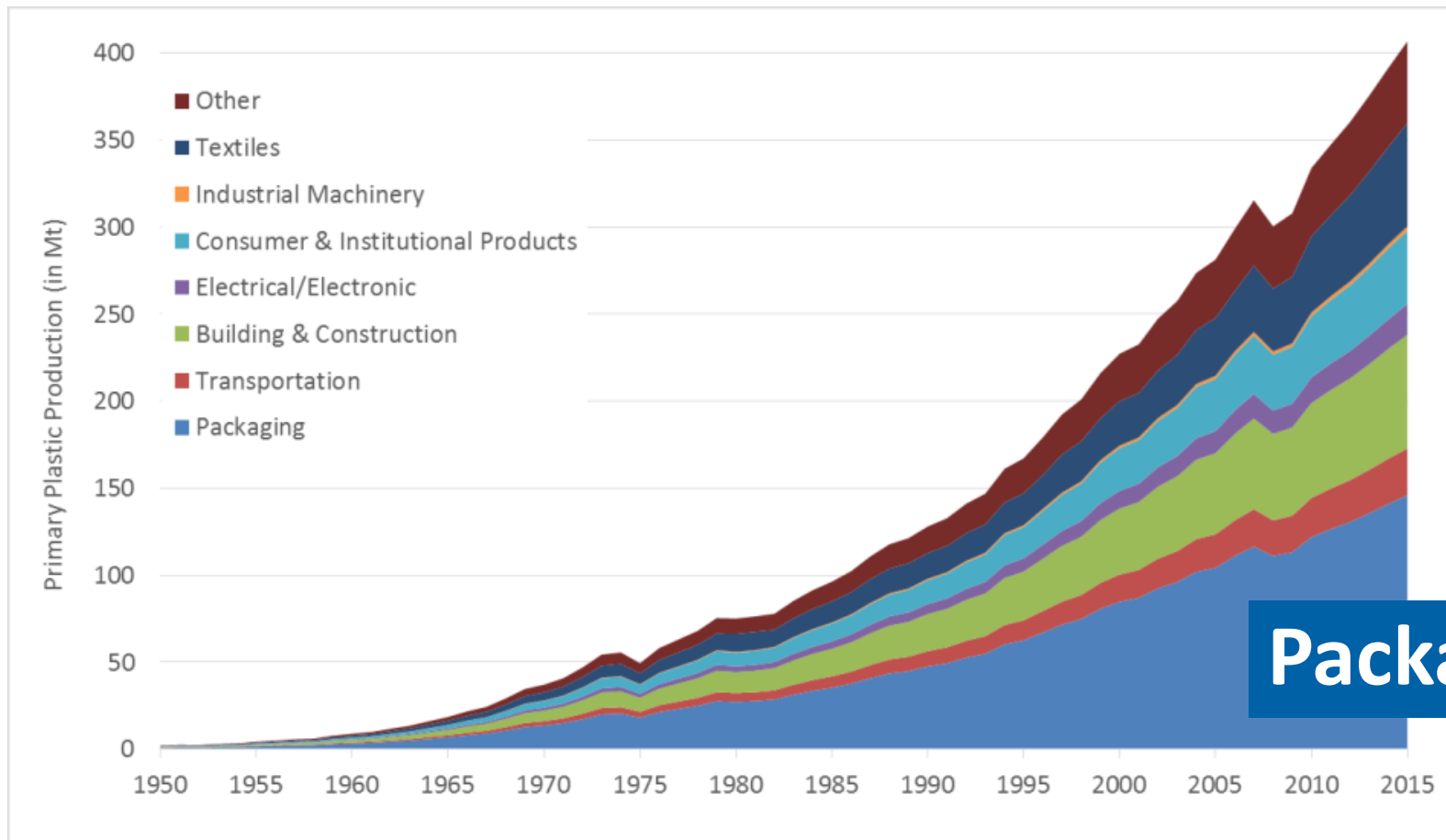


Sources: <http://www.who.int/mediacentre/factsheets/fs310/en/index2.html>  
<http://www.cdc.gov/exposurereport>

# Why focus on plastic food packaging?

- High share in global plastics production and among different food contact materials
- High exposure potential for humans and environment
- Linked with several hazardous chemicals
- High diversity of chemicals with many unknowns
- Concerns that recycling could compromise chemical safety

# Global plastics production: 380 Mt in 2015

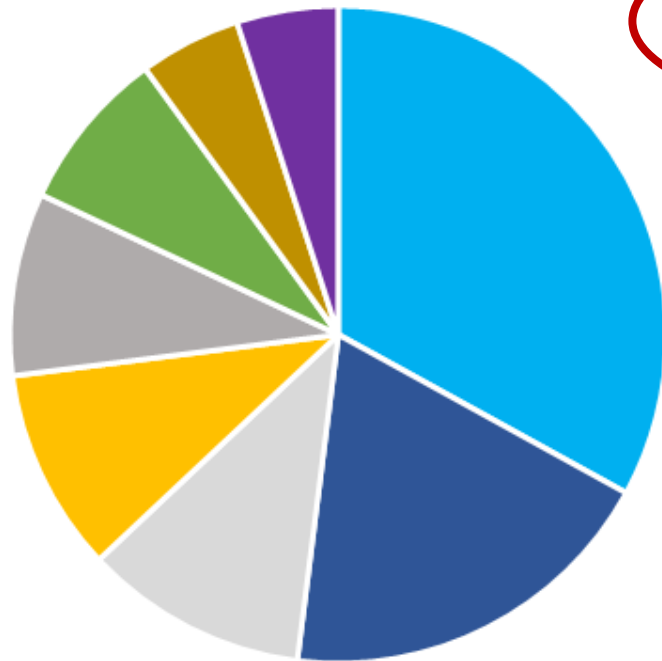


**Packaging: ~40%**

Geyer R., Jambeck J., Law K. (2017) Production, use, and fate of all plastics ever made. *Science Advances* 3(7). <http://advances.sciencemag.org/content/3/7/e1700782.full>



# Plastics' share among food packaging materials



- flexible plastics 33%
- rigid plastics 19%
- foil 11%
- paper container 10%
- metal 9%
- glass 8%
- paper 5%
- other 5%



CiTi GPS (2018). Rethinking single-use plastics. August 2018.  
<https://privateclientsolutions.citi.com/insights/citi-gps-rethinking-single-use-plastics/>

# High exposure potential for humans and environment

Direct contact with food



Environmental pollution



## Top 10 single-use plastic items found on sea shores

Drink bottles, caps, lids

Cigarette butts

Cotton buds sticks

Crisps and sweets packets and wrappers

Sanitary applications

Plastic bags

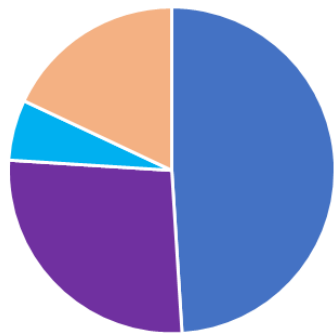
Cutlery, straws, stirrers

Drink cups, cup lids

Balloons and balloon sticks

Food containers, incl. fast food packaging

High proportion among marine litter



- single-use plastics 49%
- plastic fishing gear 27%
- other plastics 6%
- non-plastic waste 18%

Biryol D. et al. (2017). High-throughput dietary exposure predictions for chemical migrants from food contact substances for use in chemical prioritization. *Environment International* 108: 185-194. <http://dx.doi.org/10.1016/j.envint.2017.08.004>

European Parliament (2018). Plastic in the ocean: the facts, effects and new EU rules. <https://www.europarl.europa.eu/news/en/headlines/society/20181005SO15110/plastic-in-the-ocean-the-facts-effects-and-new-eu-rules/>



# Chemical composition of plastics

IAS:  
intentionally  
added substances

monomers



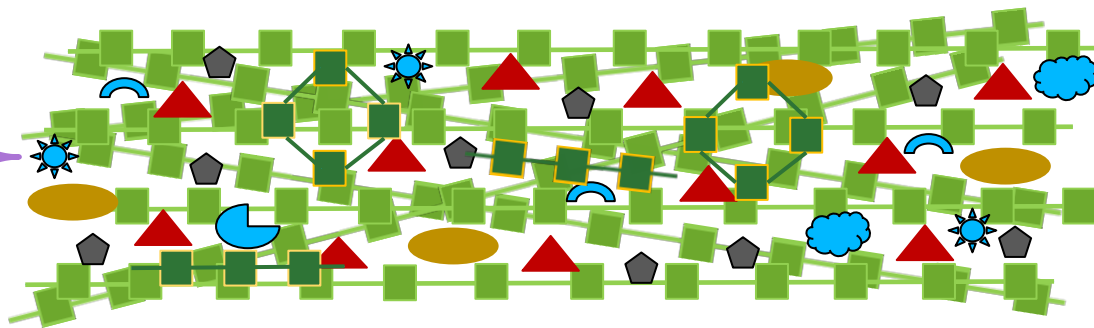
additives



processing aids  
e.g. solvents



final compounded plastics material

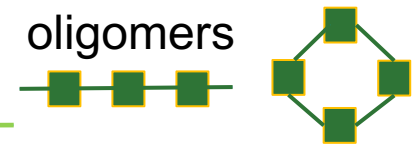


NIAS:  
non-intentionally  
added substances

impurities and  
contaminants



oligomers



reaction by-products,  
break-down products,  
neoformed products



**Dossier –  
Non-intentionally added substances (NIAS)**



June 2018, 2<sup>nd</sup> edition

DOI: 10.5281/zenodo.1265331

Birgit Geueke

# Material constituents of plastic packaging

Final compounded plastic polymers, single or in combination



+ other components such as printing inks, adhesives, foils, coatings



# Hazardous chemicals in food packaging plastics?

Familiar names: bisphenols, phthalates, brominated flame retardants, . . .  
. . . and likely many more . . .

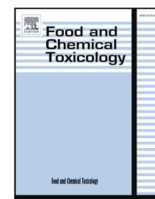
Food and Chemical Toxicology 113 (2018) 115–124



Contents lists available at [ScienceDirect](#)

Food and Chemical Toxicology

journal homepage: [www.elsevier.com/locate/foodchemtox](http://www.elsevier.com/locate/foodchemtox)



A common surfactant used in food packaging found to be toxic for reproduction in mammals



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José Luis Luque-García<sup>b,1</sup>, Carmen Cámara<sup>b,1</sup>, Raquel Ausejo<sup>c,1</sup>, Joaquín Miguel<sup>c,1</sup>,  
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## ARTICLE INFO

### Keywords:

Food packaging  
Reprotoxicity  
Surfynol  
Proteomic

## ABSTRACT

Migration from a multilayer plastic material intended for food contact showed that 2,4,7,9-tetramethyl-5-decyne-4,7-diol mixture (surfynol), used as a surfactant in the adhesive employed to build the multilayer, was transferred to water and other food simulants in contact with the plastic. When these multilayer plastics were used for containing seminal doses for artificial insemination, it was found that fertility was seriously damaged in

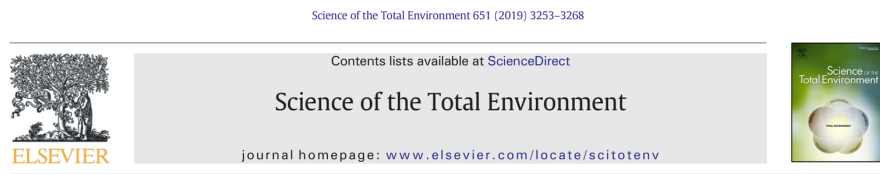
<https://doi.org/10.1016/j.fct.2018.01.044>



# Hazardous chemicals in plastic packaging: State of the art, prioritization, and assessment

“HCPP” project: multi-partner research led by FPF, 2017-2019

- Database of Chemicals associated with plastic packaging (CPPdb)
  - Hazard assessment, prioritization, and evaluation of substitution candidates
- ! covering plastic packaging for both food and non-food applications !**



Review

Overview of known plastic packaging-associated chemicals and their hazards



Ksenia J. Groh <sup>a,\*</sup>, Thomas Backhaus <sup>b</sup>, Bethanie Carney-Almroth <sup>b</sup>, Birgit Geueke <sup>a</sup>, Pedro A. Inostroza <sup>b</sup>, Anna Lennquist <sup>c</sup>, Heather A. Leslie <sup>d</sup>, Maricel Maffini <sup>e</sup>, Daniel Slunge <sup>f</sup>, Leonardo Trasande <sup>g</sup>, A. Michael Warhurst <sup>h</sup>, Jane Muncke <sup>a</sup>

<https://doi.org/10.1016/j.scitotenv.2018.10.015>



September 2018

Prioritization approaches for hazardous chemicals associated with plastic packaging

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DOI: 10.5281/zenodo.1436442

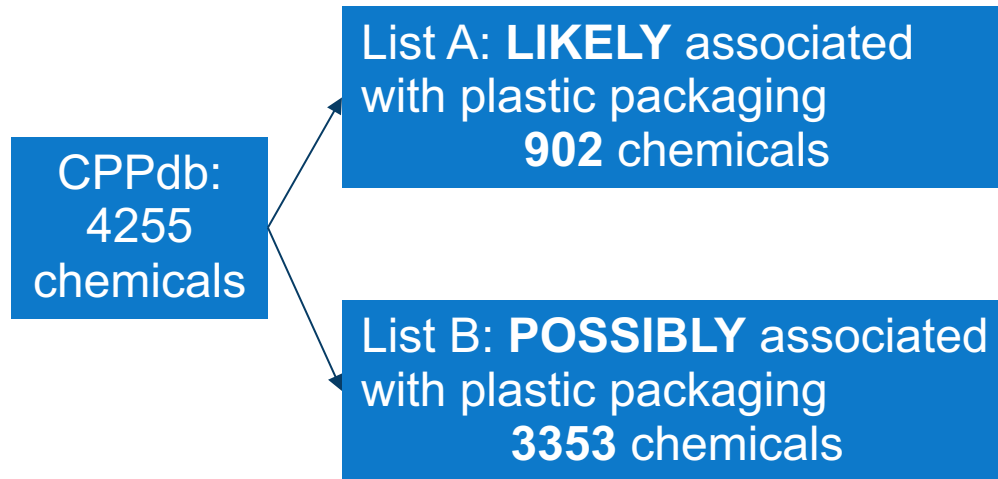
# Database of Chemicals associated with Plastic Packaging (CPPdb): Data sources

- Identification of plastic packaging-associated chemicals
  - U.S. EPA's Chemicals and Product Categories database (CPCat)
  - books and reports on analytics and use of chemicals in plastics
  - web-sites on plastics additives
- Assessment of CPPdb chemicals' hazards
  - GHS\*-aligned hazard classifications for health and environment
    - \* Globally Harmonized System for classification and labeling of chemicals
  - classifications for persistency and endocrine disruption

Groh K. et al. (2018) Overview of known plastic packaging-associated chemicals and their hazards. *Science of the Total Environment* 651: 3253-3268. <https://doi.org/10.1016/j.scitotenv.2018.10.015>



# Database of Chemicals associated with Plastic Packaging (CPPdb)



- insufficient transparency and lack of information on the actual use and levels of chemicals in plastic packaging

Current database version can be downloaded at <https://doi.org/10.5281/zenodo.1287773>

List A is also uploaded at <https://commons.healthymaterials.net/chemical-groups/279>

Groh K. et al. (2018) Overview of known plastic packaging-associated chemicals and their hazards. *Science of the Total Environment* 651: 3253-3268. <https://doi.org/10.1016/j.scitotenv.2018.10.015>



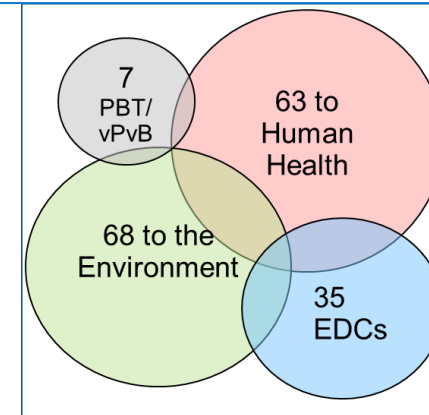
# Hazardous chemicals associated with plastic packaging

List A: **LIKELY** associated with plastic packaging  
**902** chemicals

% chemicals with 'harmonized' hazard data available:  
~13% on environmental hazards  
~27% on human health hazards

+ EDC identification, REACH/UNEP  
+ PBT/vPvB identification, EU

List of 148 top hazardous chemicals likely associated with plastic packaging, including (with overlaps):



Five phthalates prioritized as substitution candidates

intermediates  
degradation-products  
solvents<sup>other</sup>  
accelerators stabilizers  
colorants biocides  
monomers  
surfactants  
plasticizers  
flame-retardants

Groh K. et al. (2018) Overview of known plastic packaging-associated chemicals and their hazards. *Science of the Total Environment* 651: 3253-3268. <https://doi.org/10.1016/j.scitotenv.2018.10.015>

Geueke B. et al. (2018) Prioritization approaches for hazardous chemicals associated with plastic packaging. *Food Packaging Forum* <https://doi.org/10.5281/zenodo.14364425>

# Food contact chemicals among CPPdb chemicals

CPPdb sublist	Total number of chemicals	Of them, chemicals used in food contact
ListA – likely associated with plastic food packaging	902	788 (87.4%)
Top hazardous for human health based on harmonized classifications	63	55 (87.3%)
Top hazardous for the environment based on harmonized classifications	68	45 (66.2%)
PBT/vPvB classified (EU)	7	6 (85.7%)
Conservatively identified EDCs	35	35 (100%)

- the majority of top hazardous chemicals associated with plastic packaging have indications of food contact use



# Lack of harmonized hazard data for many CPPdb chemicals

CPPdb sublist	Total number of chemicals	Of them, chemicals used in food contact
ListA – likely associated with plastic food packaging	902	788 (87.4%)
Top hazardous for human health based on <b>harmonized</b> classifications	63	55 (87.3%)
Top hazardous for the environment based on harmonized classifications	68	45 (66.2%)
PBT/vPvB classified (EU)	7	6 (85.7%)
Conservatively identified EDCs	35	35 (100%)
Top hazardous for human health based on <b>advisory</b> classifications	102	97 (95.1%)

- many chemicals lacking harmonized hazard data could actually be hazardous as well

# Conclusions (1)

- numerous hazardous chemicals used or allowed for use in plastic food packaging
- assignment of 'harmonized' hazard classifications often lags behind the current scientific understanding
- extreme complexity hinders comprehensive overview and risk assessment, especially with regard to mixture toxicity
- non-intentionally added substances pose unique challenges for systematic identification, toxicity testing, risk assessment

# Plastics recycling: Chemical safety aspects

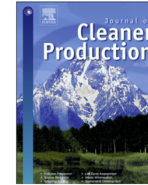
Journal of Cleaner Production 193 (2018) 491–505



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Journal of Cleaner Production

journal homepage: [www.elsevier.com/locate/jclepro](http://www.elsevier.com/locate/jclepro)



Review

## Food packaging in the circular economy: Overview of chemical safety aspects for commonly used materials



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### ABSTRACT

Food packaging facilitates storage, handling, transport, and preservation of food and is essential for preventing food waste. Besides these beneficial properties, food packaging causes rising concern for the environment due to its high production volume, often short usage time, and problems related to waste management and littering. Reduction, reuse, and recycling, but also redesign support the aims of the circular economy. These tools also have the potential to decrease the environmental impact of food packaging. In this article, we focus on chemical safety aspects of recycled food packaging, as recycling is currently seen as an important measure to manage packaging waste. However, recycling may increase the levels of

<https://doi.org/10.1016/j.jclepro.2018.05.005>

- Metals and glass are **‘permanent’** materials with theoretically unlimited recycling
- Plastics and paper are **‘non-permanent’** materials that degrade during (mechanical) recycling, thus requiring addition of virgin material during each recycling round



# Typical contaminants in recycled plastics

	Possible origin	Examples
Flavor, aroma, odor compounds	Previous food and non-food applications	Limonene, p-cymene
Oligomers, monomers and derivatives	Production of virgin materials; degradation during use and recycling	Linear and cyclic oligomers, acetophenone, benzaldehyde
Additives and their degradation products	Production of virgin materials; degradation during use and recycling; cross-contaminations	UV absorbers, antioxidants, plasticizers, other additives
Contamination by non-food grade hazardous substances	Mixed collection of non-food grade plastics; adulteration; consumer misuse	Brominated flame retardants, dioxin-like compounds, sulfuric compounds
Inorganic elements	Catalysts; environmental origin; recycling infrastructure	Heavy metals

- need to ensure that recycling does not compromise FCM's safety

# Moving away from single-use plastics: What are the alternatives?

- Important not to “blindly” substitute with other materials, but properly consider functional performance, energy and resource efficiency, recyclability, and **chemical safety**
- Opportunity to develop better and safer FCMs and FCAs and improve FCM regulation and management frameworks
  - discussed in Muncke et al. (2017). Scientific challenges in the risk assessment of food contact materials. *Environmental Health Perspectives* 125(9):095001. <https://doi.org/10.1289/EHP644>
- Ongoing project “Food Contact Chemicals & Human Health” (FCC&HH) aims to systematically map data on FCC’s contribution to human exposure and potential health effects
- A **translational science event** for the FCC & HH project will be held on June 12-14, 2019, near San Francisco, U.S.
  - further information will soon be posted on the FPF website



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ALL INFORMATION FREELY ACCESSIBLE:  
[www.foodpackagingforum.org](http://www.foodpackagingforum.org)



Funding: MAVA foundation



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Bill Walsh  
*Healthy Buildings Network*



Thank you for your attention!

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