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A comprehensive overview of plastic monomers, additives and processing aids

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Evidence of bad recycling practices: BFRs in children's toys and food-contact articles
Guzzonato et al. (2017)

chemicals used in plastics ?

potential hazards ?

Current research

Monomers, additives and processing aids are highly diverse

- ECHA + industry: over 400 plastic additives registered under REACH at above 100 tonnes/year
- Groh et al. (2018): over 3’000 additives in plastic packaging
- SpecialChem additives database: over 30’000 commercially available formulations

Only few substances are regularly discussed in scientific literature

➔ Need for an overview of their chemical identities and priority setting

Compiling the database

Plastic Monomers, Additives and Processing Aids

► Establishing a **comprehensive additive database**

- Identification of relevant data sources
  - scientific, industrial and regulatory sources

- Inclusion of relevant substances and information

Name, CASRN,… | use data | tonnage data | hazard data | regulatory status | regional use status

- Categorization of substance types & use patters

Industrial Sector		
	Packaging	Films, bottles, pots, tubs, trays,…
	Building & Construction	Profiles, coverings, pipes…
	Electronics	Large & small household appliances, ICT equipment & consumer electronics…
	Agriculture	Mulch films, silage films, pipes,…
	Household & Others	Medical products, toys, kitchen utensils,…
	Textiles	Clothing, technical, furniture textiles,…

TV
radio
modem

Inclusion of relevant substances and information

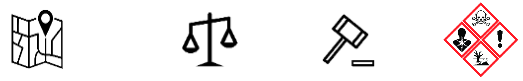
a) Identify relevant substances
   - Search for plastic-related keywords
   - Search for CASRNs

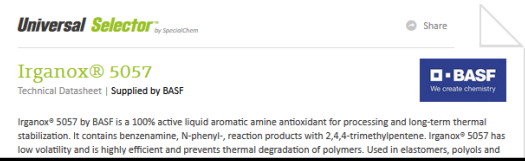
b) Verify CASRNs using SciFinder

c) Assign confidence to sources and substances

d) Include further information

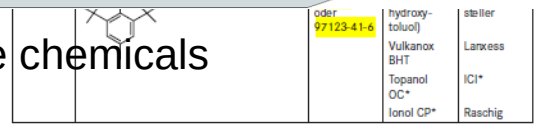
regional use status | tonnage data | legal status | hazard data





Type	Included Sources
Regulator-Harmonized	- EU C&L inventory – harmonized - EU REACH Authorization List - EU REACH PBT Assessment List - EU REACH EDC Assessment List - EU REACH SVHC List - Japanese GHS Classification Results - Australian Hazardous Chemicals Information System - OECD eChemPortal - IARC Classified Agents List
Company-reported	- EU REACH registration dossiers - EU C&L inventory – not harmonized

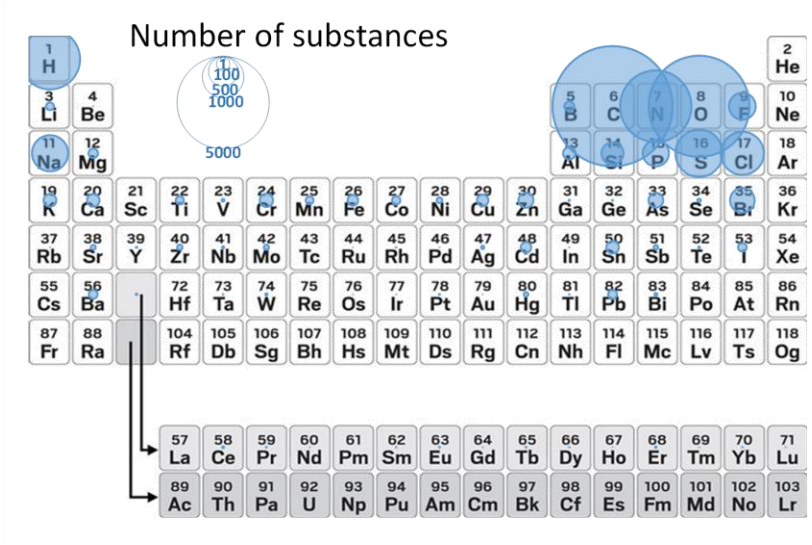
Other:
- OSPAR List of Chemicals for Priority Action
- Stockholm Convention
- High production volume chemicals
- Montreal Protocol
- Rotterdam Convention



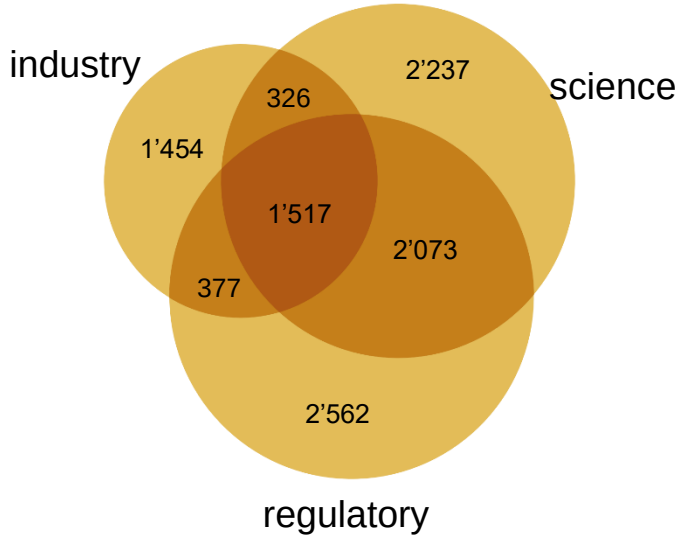
Results – Overview of substances

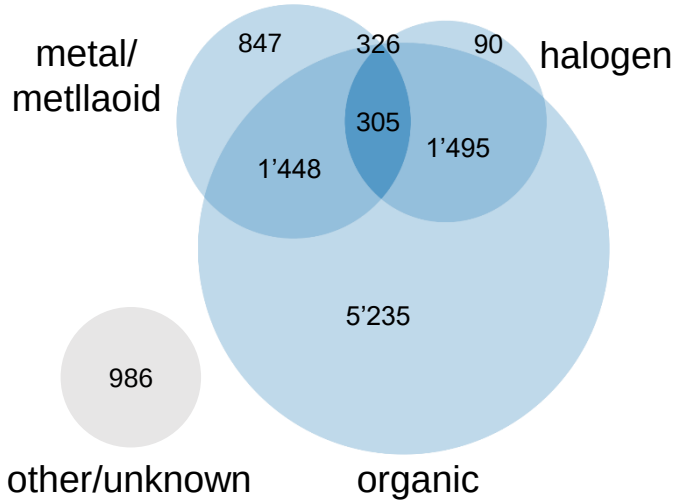
- more than 10’000 CASRNs related to plastics
- 50% only mentioned in one type of source
- dominated by organic substances

Substance Types



Information Origin

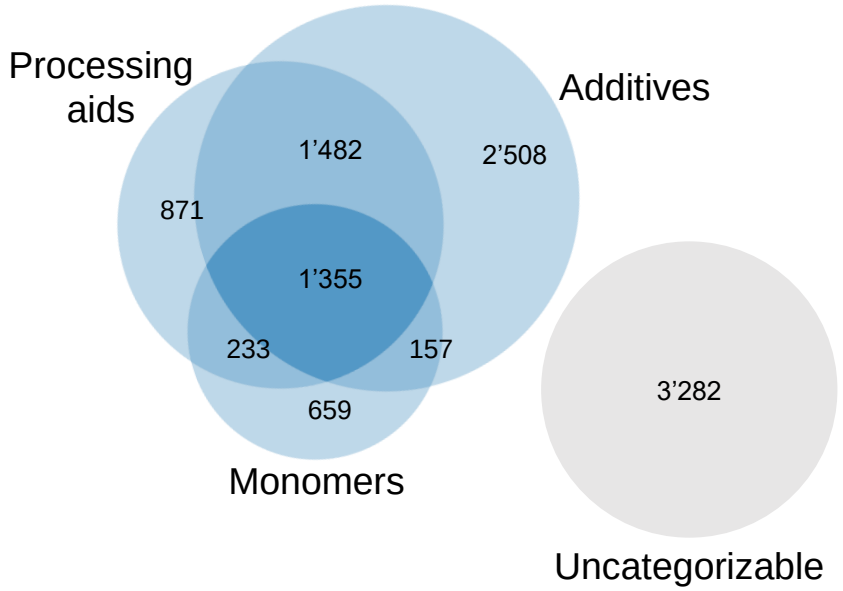


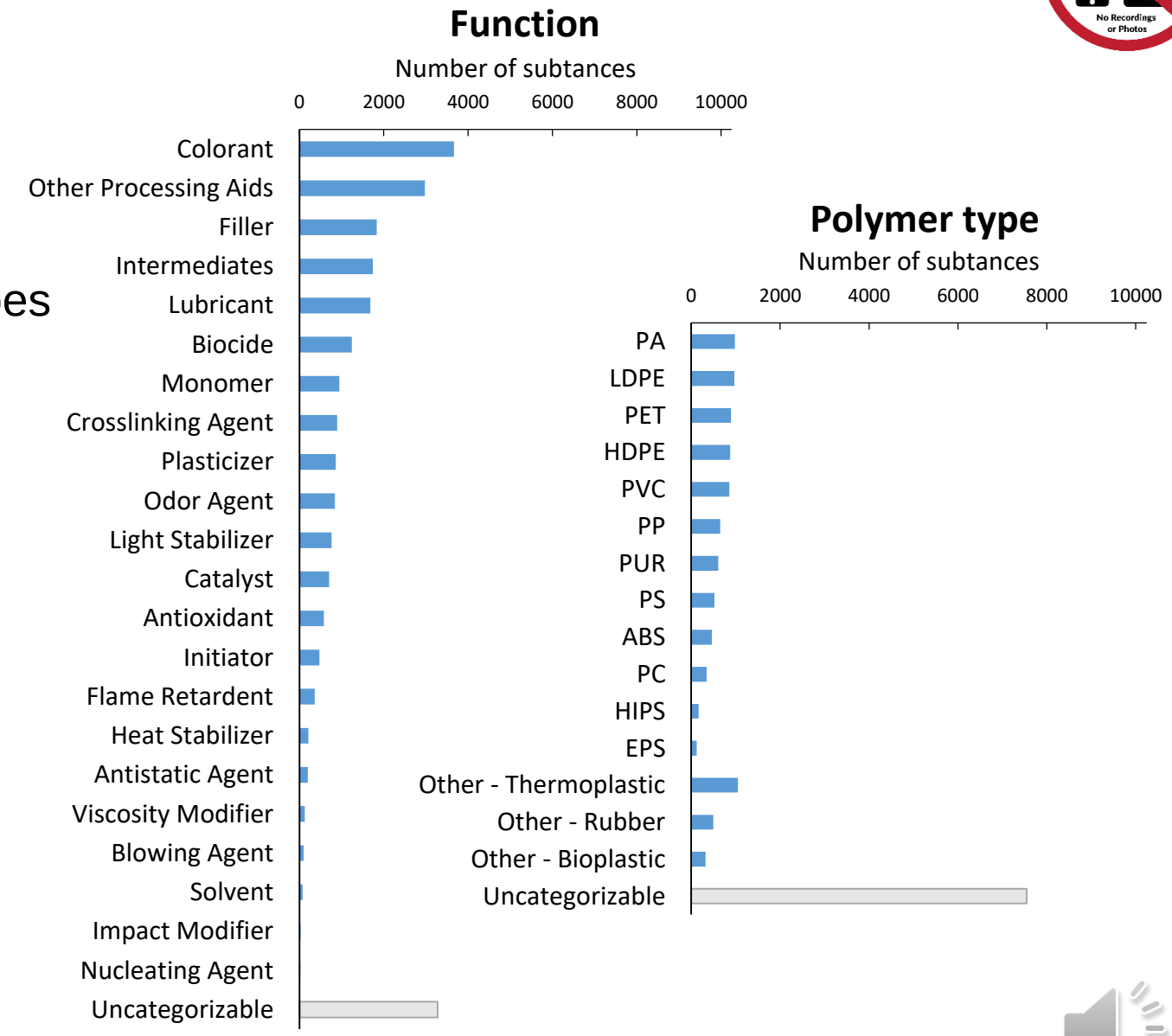


Results – Use patterns

Many substances

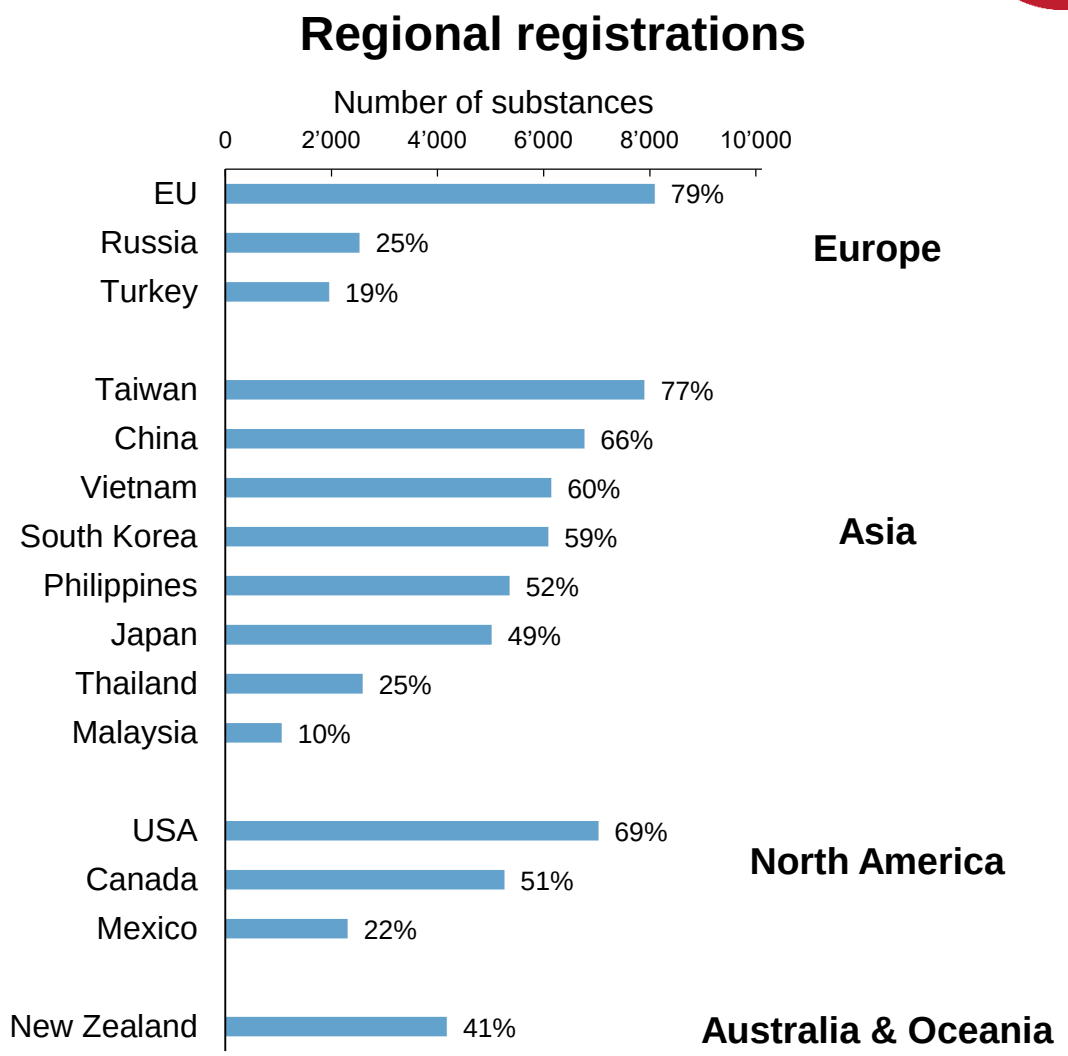
- fulfill several functions
- are compatible with several polymer types
- are used in several industrial sectors





Results – Regional relevance

- 10–80% of substances registered in inventories from different parts of the world
- the commercial status, extent of use and concentrations in plastic articles remain unknown



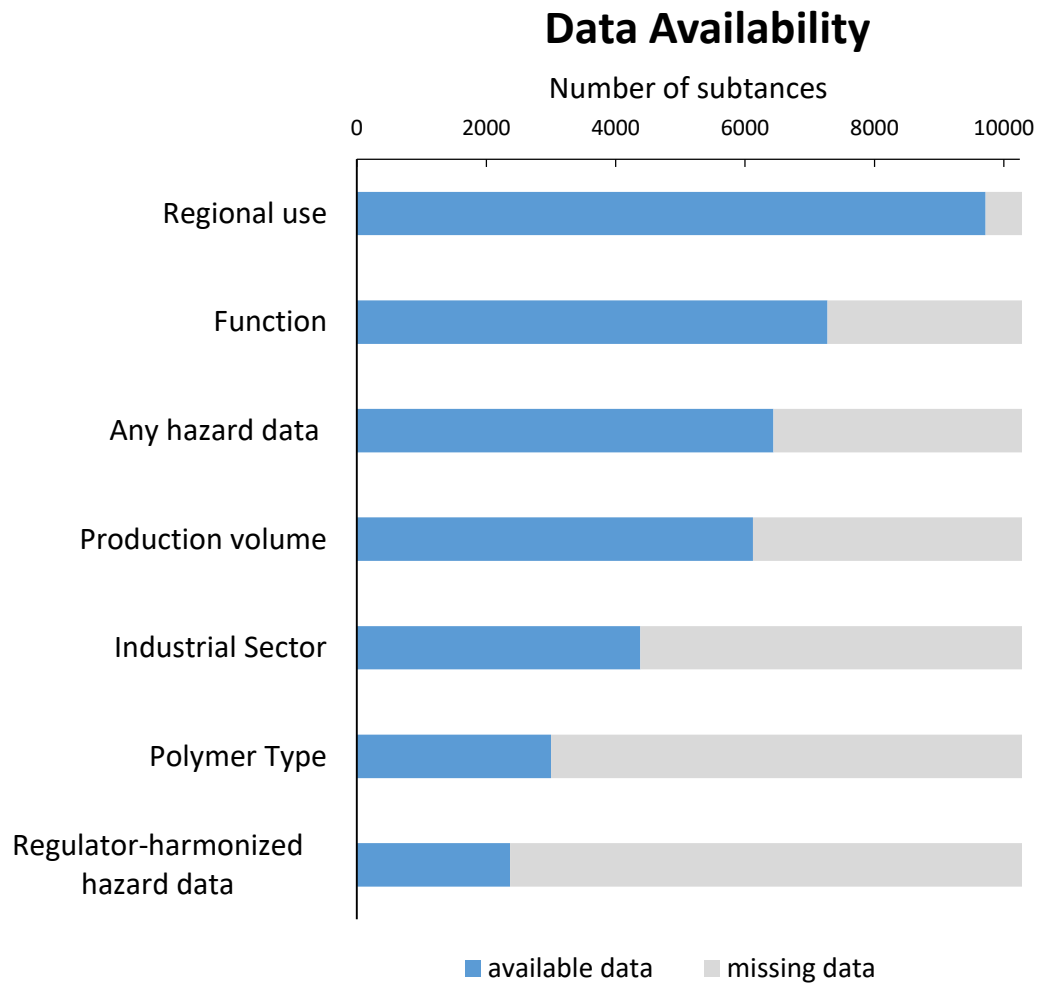
Results – Substances of (potential) concern

- more than 2’400 substances, 25% of the identified substances
- 900 substances of (potential) concern appear on positive lists for food contact materials

HAZARD TYPE		TOTAL	HPVC	NOT REGULATED[1]	NOT RESEARCHED[2]
PBT	Persistent, bioaccumulative & toxic	57	26	10	10
CMR	Carcinogenic, mutagenic, reprotoxic	951	501	350	91
ED	Endocrine disrupting	30	17	3	3
AqTox	Chronic aquatic toxicity	1’646	754	897	188
STOT	Specific target organ toxicity	891	562	331	57
TOTAL		**2’486**	**1’254**	**1’327**	**266**

[1] regulated by international regulatory lists or in the EU, USA, Japan or South Korea
[2] no scientific references according to SciFinder

Data availability & uncertainties



Remaining data and knowledge gaps:

- Regulator-harmonized hazard data
- Polymer types
- Use details and concentration ranges

Limitations

Potential bias in sources

- Digitized sources
  ➔ optical character recognition tools
- Focus on sources where CASRN are assigned
  ➔ cheminformatics tools
- Focus on high-income countries regulatory sources
  ➔ improving availability of regulatory lists
- Only GHS hazard data were used
  ➔ accessibility and harmonization of other studies

Potential processing mistakes

- Keyword search
  ➔ natural language processing

Conclusion

Messy situation regarding chemicals in plastics

- Thousands of diverse substances (potentially) used; 25% having concerning properties
- Only partially researched and regulated
- A lack of transparency on their actual occurrence in products and the concentration levels

Threat to a safe and sustainable circular economy!

Outlook

Following policy actions are urgently needed

- Design for recycling – also on the chemical level
- Supply chain transparency
- Expand focus of research, regulation and monitoring

Research needs and opportunities

- Target list for non-targeted analysis
- Support alternatives assessment
- New research foci
- Need for analytical standards
- Need for standardized terminology regarding chemicals

Publication of paper and database soon

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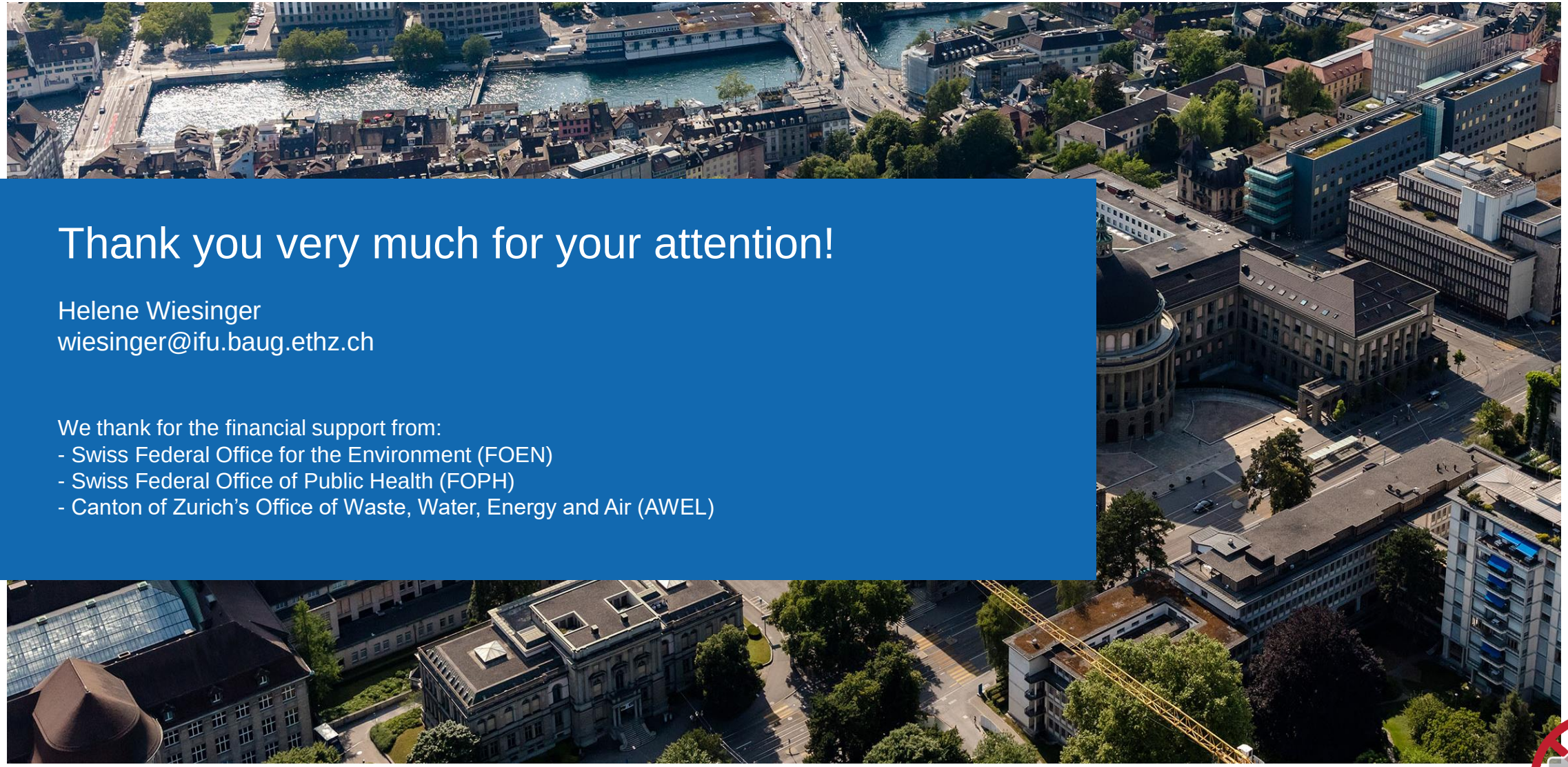

Thank you very much for your attention!

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Sources of graphics

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- Black kitchen utensil (by Magdalena Klotz)