

# „Non-dietary cumulative risk assessment of plant protection products and biocidal products“

17.03.2026, Düsseldorf, Germany

**Dr. Vincent Blaschke**

**Unit 64 / Toxicology of Products and their Safe Use**

**Department 6 / Pesticides Safety**



# Plant protection products

- Prevent, destroy, mitigate, and repel pests
  - Used to protect **plants and plant products**
- **Herbicides, insecticides, fungicides**
  - Molluscicides, acaricides, bactericides, etc.
  - Plant growth regulators, repellents, pheromones



Field crops



Vineyards & orchards



Seed treatment

# Biocidal products

- Prevent, destroy, mitigate, and repel pests
- Used to protect **anything but** plants and their products
- Human hygiene, healthcare
- Rodenticides, Insecticide, repellents, attractants
- Wood and in-can preservatives, coating agents
- Antifouling products



Disinfectants



Pest agent controls



Preservatives



Other biocidal products

# Exposure assessment

## Non-dietary exposure assessment



## Dietary exposure assessment

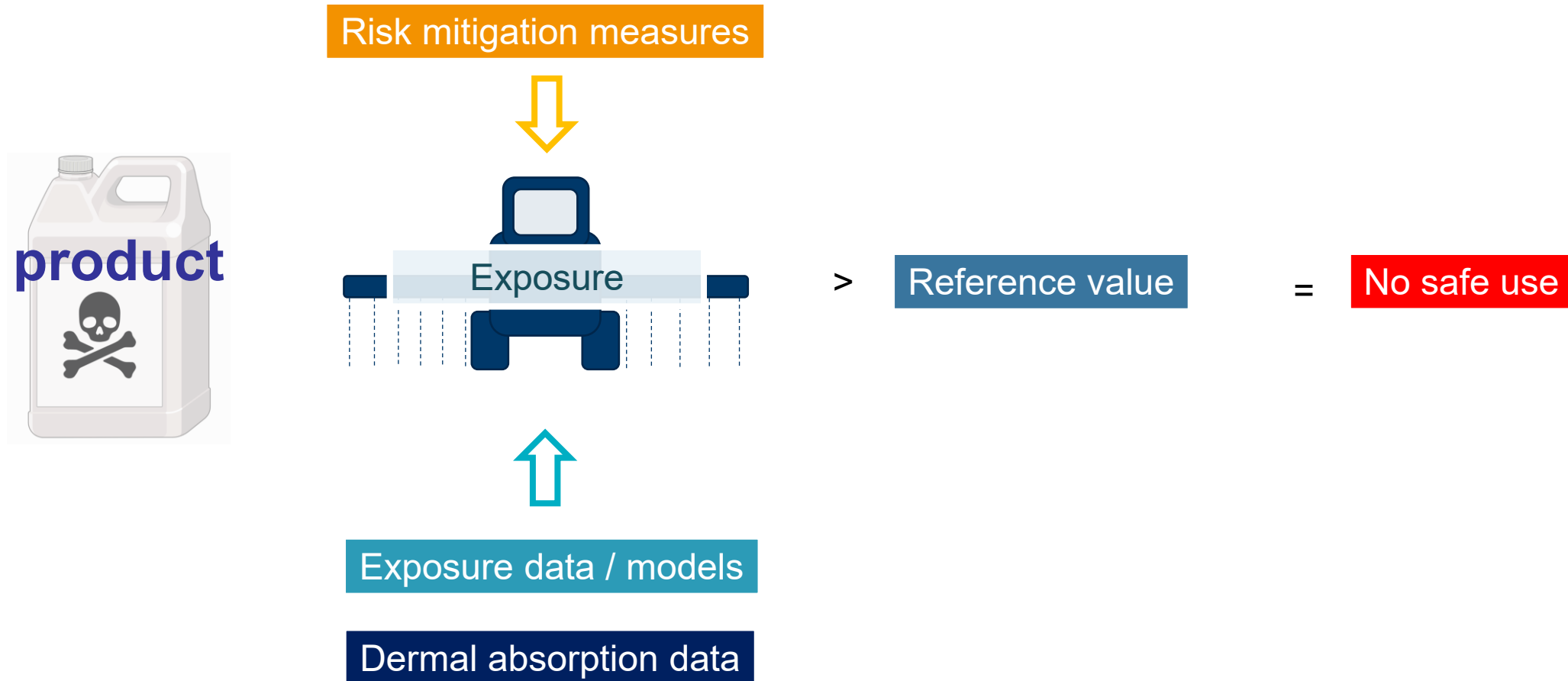


A(O)EL



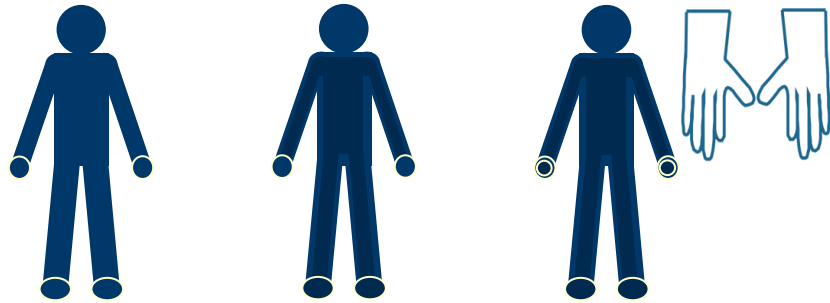
ADI / ARfD

# Risk assessment



# Risk mitigation measures – Plant protection products

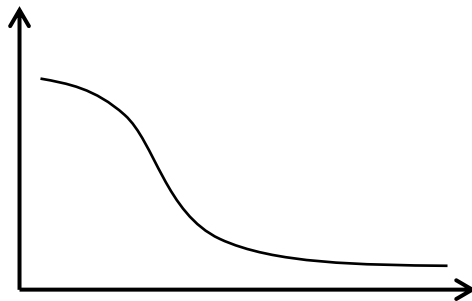
## Workwear & protective equipment



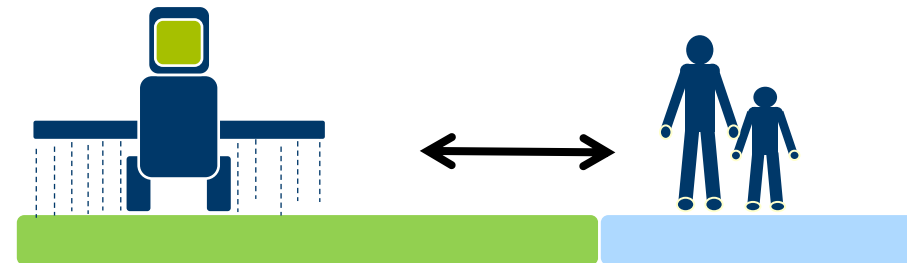
## Drift reduction



## Re-entry restrictions



## Buffer zones



# Risk mitigation measures – Biocidal products



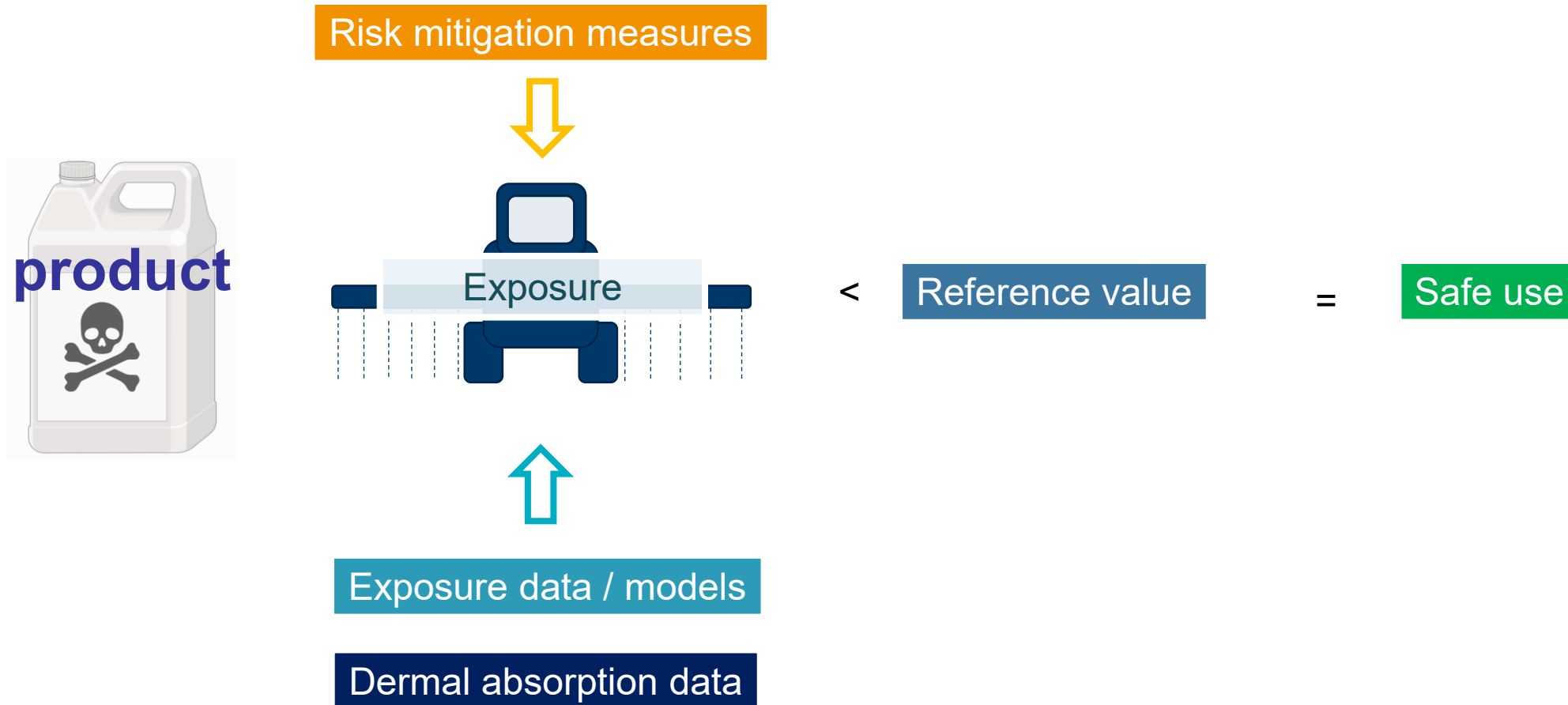
Non-professional users

→ No protective clothing or other personal responsibility

## Technical mitigation measures



# Risk assessment



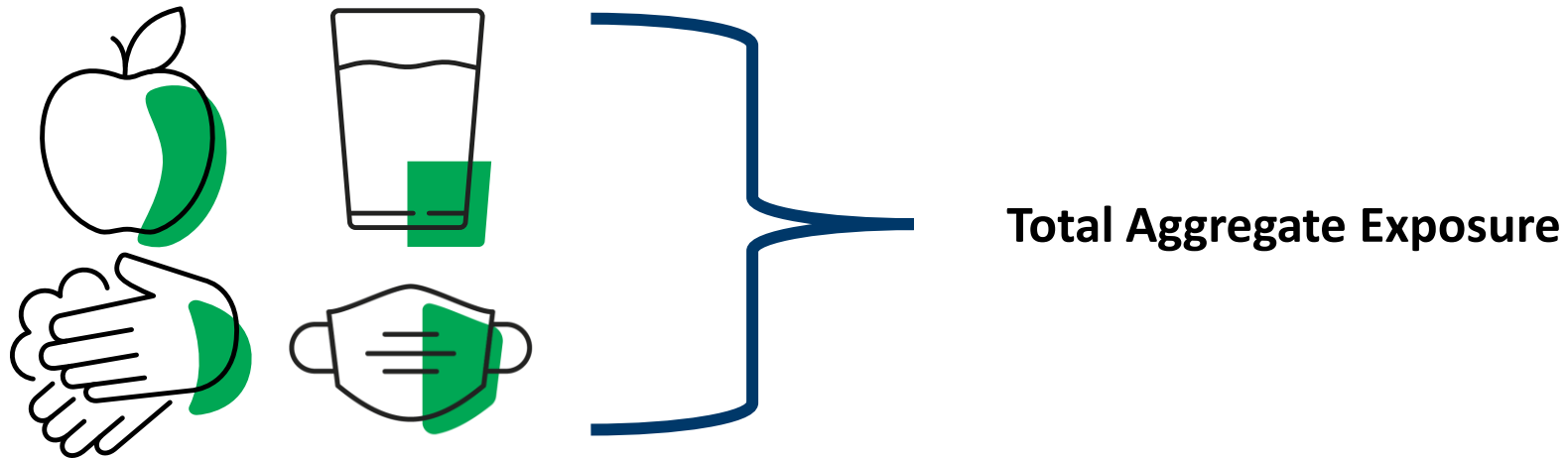
# Cumulative Risk Assessment

# Aggregate vs. Cumulative Risk Assessment

## Aggregate Risk Assessment

**Definition:** Assessment of total exposure to a single active substance via multiple exposure pathways

Exposure pathways:



**Goal:** Determination of the total aggregate exposure to a single substance in comparison to toxicological reference values (e.g. AEL/AOEL, ADI)

# Aggregate vs. Cumulative Risk Assessment

## Cumulative Risk Assessment

**Definition:** Assessment of the combined health risks from exposure to multiple active substances, for example from a single product

Key principle:

Multiple active substances  Combined toxicological effect  Cumulative exposure

**Goal:** To assess whether mixtures of substances within a product pose an unacceptable risk to human health.

# Dose addition vs independent addition

## Dose addition

- Assume that substances contribute to a common toxicological effect
- Behave if they were dilutions of the same compound

### **Requirements:**

Toxicological reference values are needed

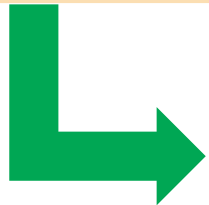
## Independent addition

- Assumes that substances act through different biological mechanisms
- Produce statistically independent effects

### **Requirements:**

Detailed dose-response data for each substance

Reliable information on toxicological mechanisms

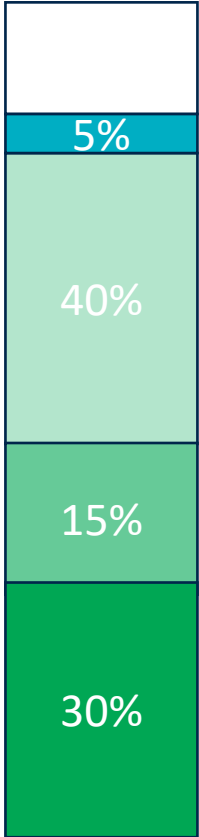


**Dose addition applied as default approach**

# Cumulative exposure

## Tier 1

Hazard Index



Dose addition



# Tiered Approach – Cumulative Risk Assessment – Tier I

**If risk is acceptable:**

→ Stop further refinement

→ **Use of the product/  
mixture is considered  
safe** based on currently  
available data and  
information

**Tier I: HQ**

Evaluate each substance of the product

**If acceptability criterion is  
NOT met:**

→ Consider refinement of  
exposure estimate or risk  
mitigation measures and/or  
hazard assessment as  
appropriate at each tier

→ **Consider next higher tier if  
possible based on available  
data e.g. to consider mode  
of action / mechanistic  
data**

# Hazard Quotient vs Hazard Index

## Hazard quotient (HQ)

Ratio of the estimated exposure to the toxicological reference value derived for a single substance

$$HQ = \frac{Exposure}{Reference\ value}$$

HQ  $\leq$  1  $\rightarrow$  Risk is considered **acceptable**

HQ  $>$  1  $\rightarrow$  Risk is considered **unacceptable**

Reference values examples:

- ADI (Acceptable Daily Intake)
- AOEL (Acceptable Operator Exposure Level)
- AEL (Acceptable Exposure Level)
- ARfD (Acute Reference Dose)

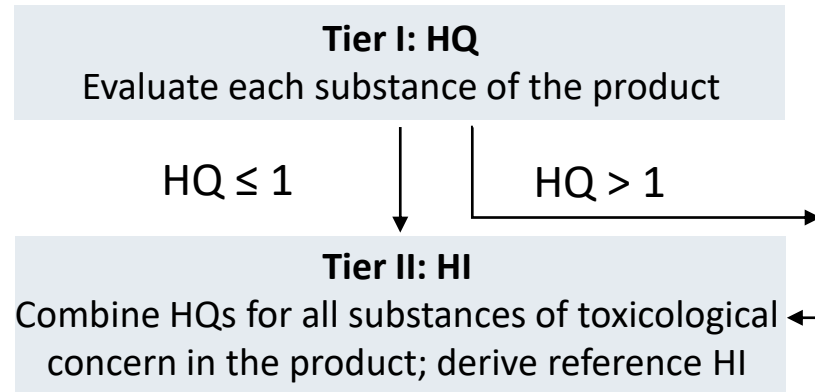
**Assessment of the risk of a single substance**

# Tiered Approach – Cumulative Risk Assessment – Tier II

**If risk is acceptable:**

→ Stop further refinement

→ **Use of the product/  
mixture is considered  
safe** based on currently  
available data and  
information



**If acceptability criterion is NOT met:**

→ Consider refinement of exposure estimate or risk mitigation measures and/or hazard assessment as appropriate at each tier

→ **Consider next higher tier if possible based on available data e.g. to consider mode of action / mechanistic data**

# Hazard Quotient vs Hazard Index

## Hazard index (HI)

Describes the sum of several Hazard Quotients for substances in one product

$$HI = HQ_1 + HQ_2 + HQ_3 \dots$$

$HI \leq 1 \rightarrow$  cumulative risk is considered **acceptable**

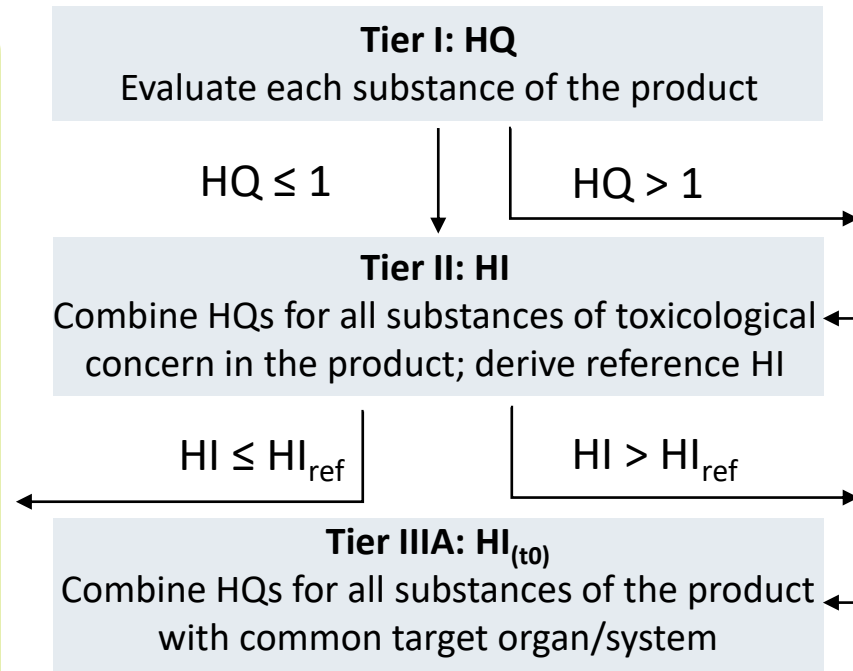
$HI > 1 \rightarrow$  cumulative risk is considered **unacceptable**

# Tiered Approach – Cumulative Risk Assessment – Tier II

**If risk is acceptable:**

→ Stop further refinement

→ **Use of the product/  
mixture is considered  
safe** based on currently  
available data and  
information



**If acceptability criterion is  
NOT met:**

→ Consider refinement of  
exposure estimate or risk  
mitigation measures and/or  
hazard assessment as  
appropriate at each tier

→ **Consider next higher tier if  
possible based on available  
data e.g. to consider mode  
of action / mechanistic  
data**

HI<sub>ref</sub> = 1, except synergism effects are known/ expected

# Cumulative Assessment Groups (CAGs)

## Definition:

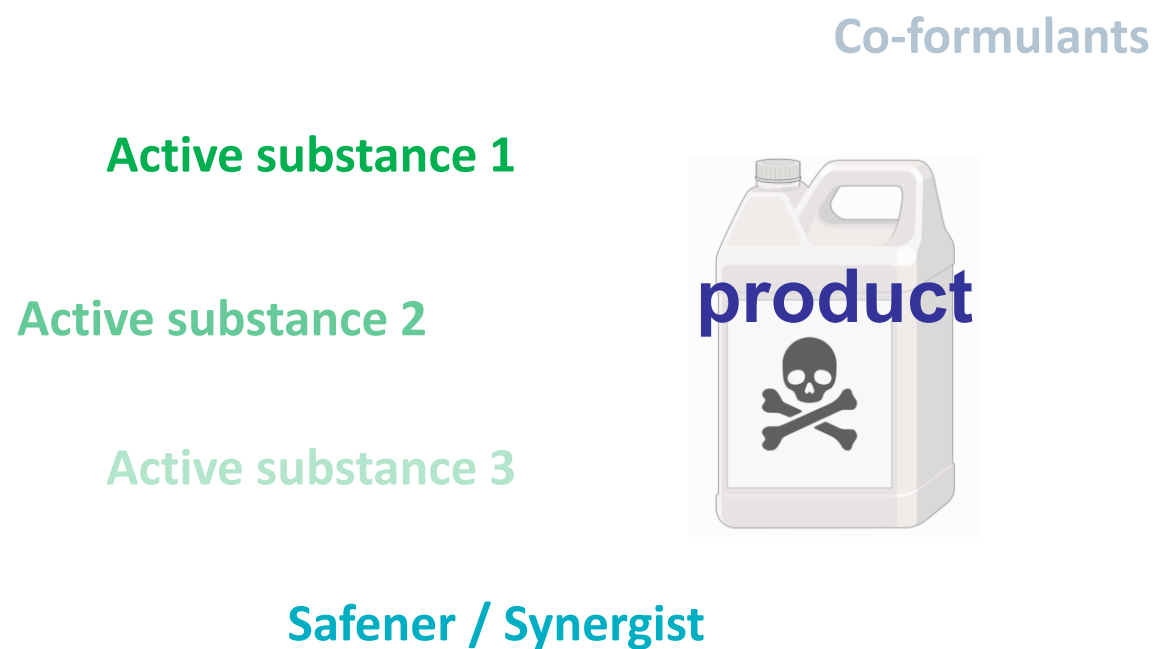
**Cumulative Assessment Groups (CAGs) are groups of active substances that are grouped on the basis of:**

- A common toxicological mechanism
- A common target organ or biological system

## Key principle:

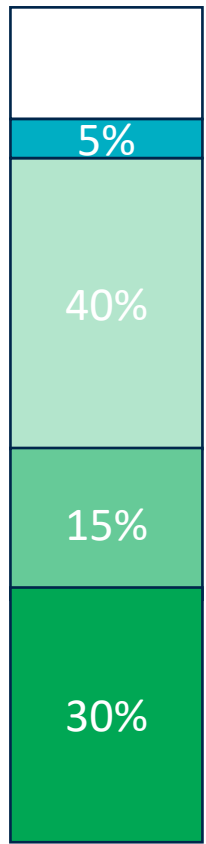
Multiple active substances → Similar toxicological endpoint → Cumulative risk assessment

# Cumulative exposure



## Tier 1

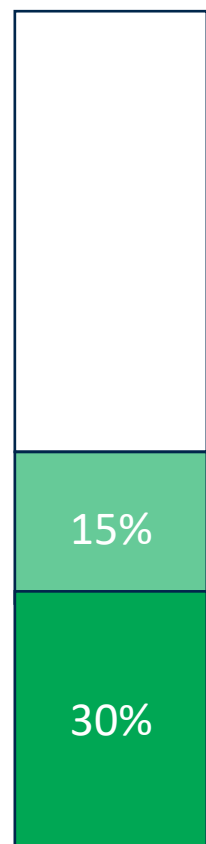
Hazard Index



Dose addition

## Tier 2

Hazard Index



Common target organs / systems

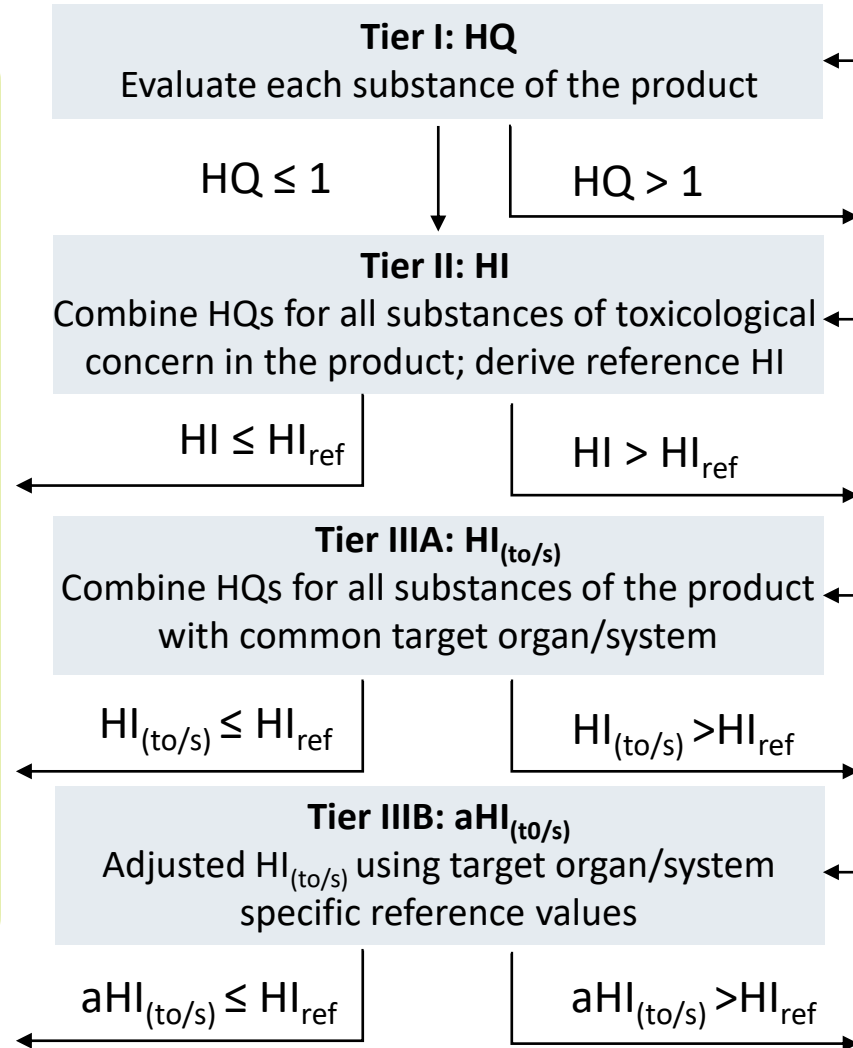


# Tiered Approach – Cumulative Risk Assessment – Tier IIIB

**If risk is acceptable:**

→ Stop further refinement

→ **Use of the product/  
mixture is considered  
safe** based on currently  
available data and  
information



**If acceptability criterion is NOT met:**

→ Consider refinement of exposure estimate or risk mitigation measures and/or hazard assessment as appropriate at each tier

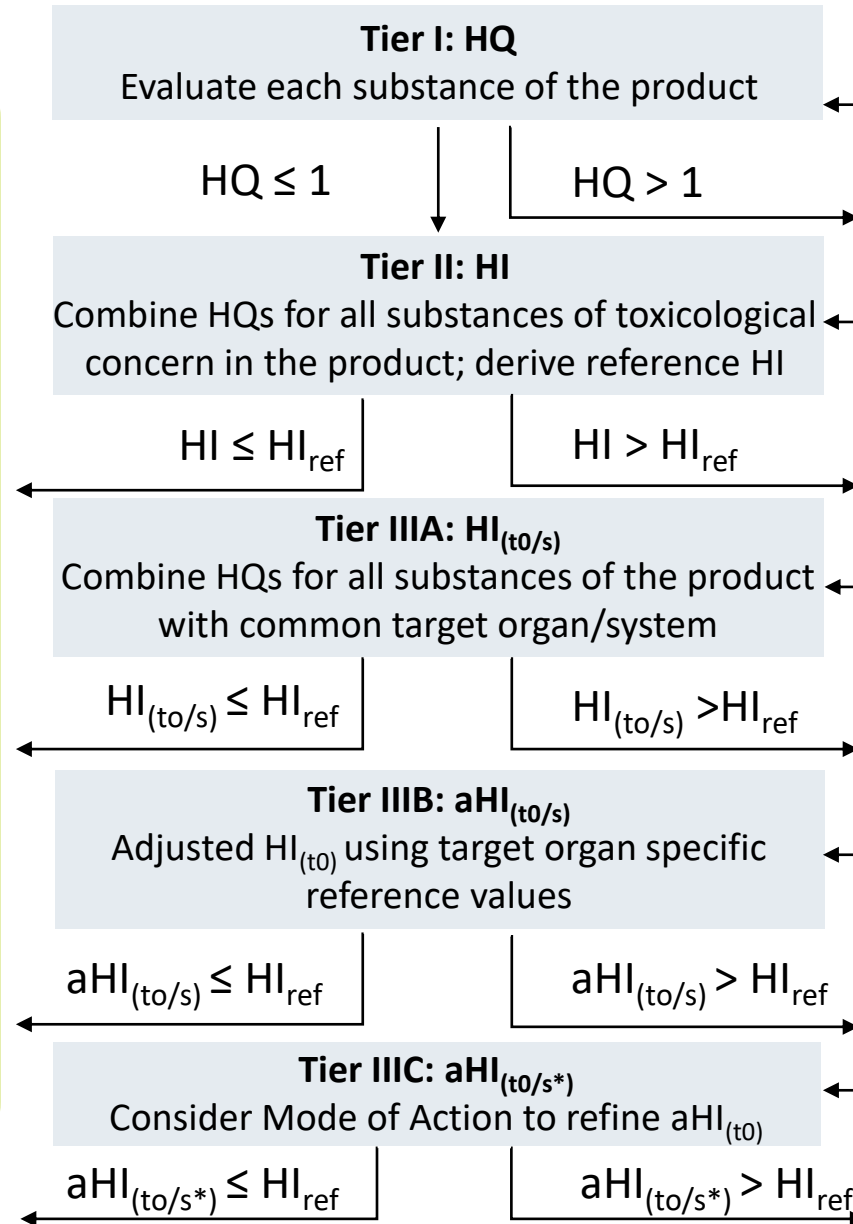
→ **Consider next higher tier if possible based on available data e.g. to consider mode of action / mechanistic data**

# Tiered Approach – Cumulative Risk Assessment – Tier IIIC

**If risk is acceptable:**

→ Stop further refinement

→ **Use of the product/  
mixture is considered  
safe** based on currently  
available data and  
information



**If acceptability criterion is NOT met:**

→ Consider refinement of exposure estimate or risk mitigation measures and/or hazard assessment as appropriate at each tier

→ Consider next higher tier if possible based on available data e.g. to consider mode of action / mechanistic data

→ **Use of product/mixture cannot be considered safe** if neither exposure estimate or hazard assessment can be further refined. Further tests might be necessary.

# Regulatory issues in Cumulative Risk Assessment

## 1. Identification of relevant substance groups

- Grouping into CAGs based on:
  - Common mode of action
  - Common target organ
  - Similar toxicological endpoints

## 2. Data availability and data gaps

- Reliable CRA requires extensive data on
  - Exposure levels
  - Toxicological mechanisms
  - Co-occurrence of substances

## 3. Methodical complexity

- CRAs involve complex approaches
  - Mixture toxicity concepts (e.g. dose addition)
  - Probabilistic exposure modelling
  - Large datasets from monitoring programs

## 4. Interpretation of results for risk management

- Which substances contribute most to the risk
- Which risk management measures are appropriate



# Thank you for your attention

Vincent Blaschke

T +49 30 18412-76406

Vincent.blaschke@bfr.bund.de

German Federal Institute for Risk Assessment

[bfr.bund.de/en](https://bfr.bund.de/en)



valid for texts produced by the BfR  
images/photos/graphics are excluded unless otherwise indicated

**BfR** | Identifying Risks –  
Protecting Health

Consumer health protection to go

**BfR2GO – the BfR Science Magazine**


[bfr.bund.de/en/publications/bfr2go/](https://bfr.bund.de/en/publications/bfr2go/)

Follow us

 @bfrde | @bfren | @Bf3R\_centre

 @bfrde


 [youtube.com/@bfr\\_bund](https://youtube.com/@bfr_bund)

 [social.bund.de/@bfr](https://social.bund.de/@bfr)

 [linkedin.com/company/bundesinstitut-f-r-risikobewertung](https://linkedin.com/company/bundesinstitut-f-r-risikobewertung)

 [podcast.bfr.bund.de](https://podcast.bfr.bund.de)

 [threads.net/@bfrde](https://threads.net/@bfrde)

 [bsky.app/profile/bfrde.bsky.social](https://bsky.app/profile/bfrde.bsky.social)