

USEtox: linking element between safety & sustainability

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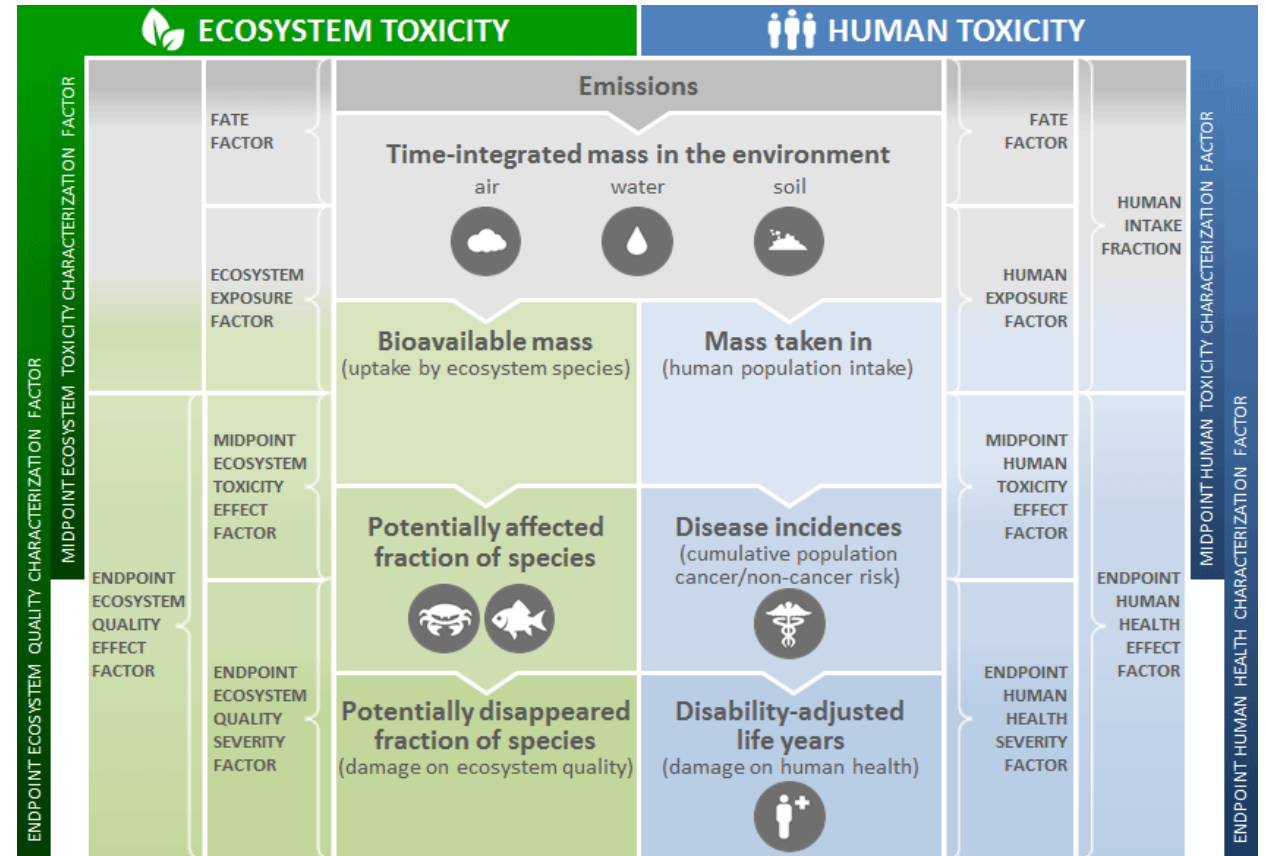
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<http://doi.org/10.1039/D0GC01544J>

USEtox: Safety & Sustainability Metrics for SSbD

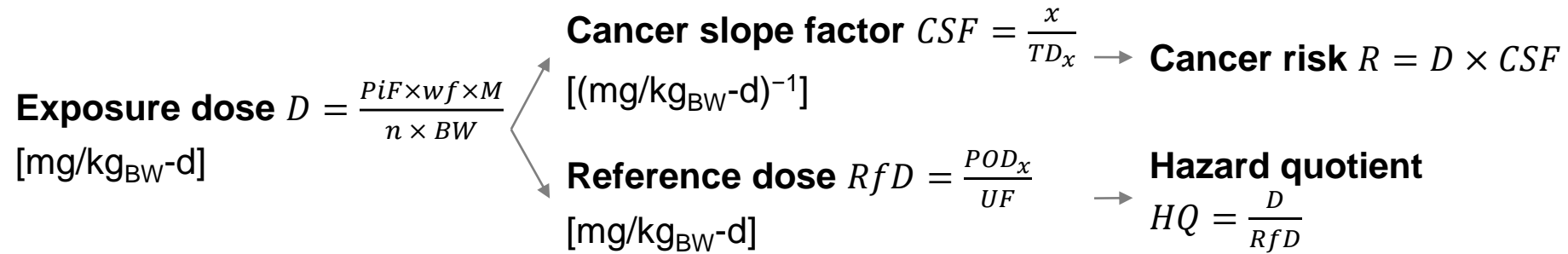
- Global UNEP/SETAC scientific consensus model USEtox
- Defined criteria for consensus:
 - Based on mature science
 - Outputs within outputs of other models
 - Only incl. most influential aspects
 - Endorsed by all involved scientists
 - Transparent and well-documented
- **USEtox 3: hazard & LCA metrics**



<http://usetox.org/documentation>

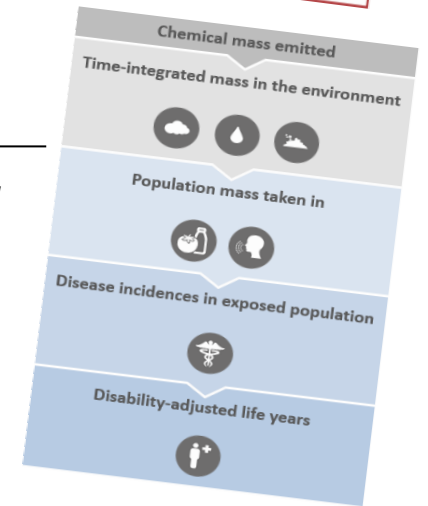
USEtox: Safety & Sustainability Metrics for SSbD

Chemical risk assessment – Human and ecological safety



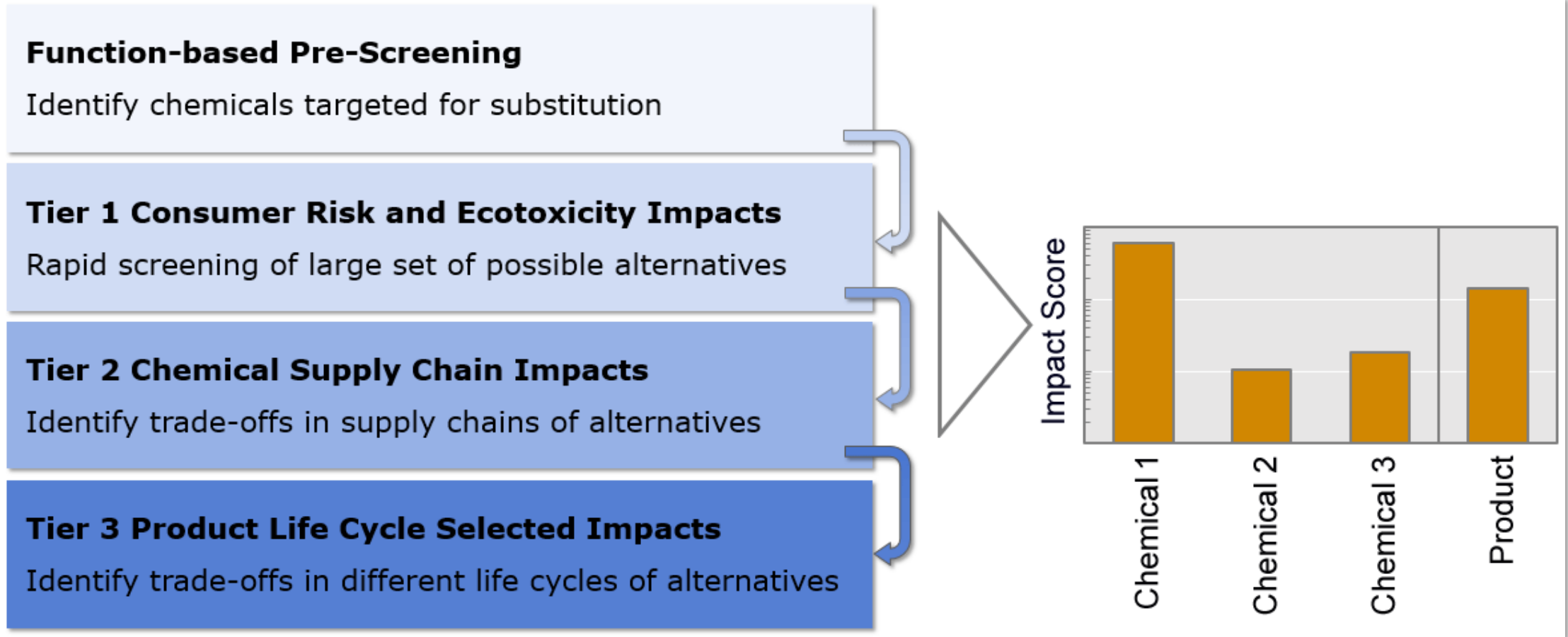
	Corrosive	Danger only (health)
	Toxic	Danger only
	Health Hazard	Danger or Warning
	Irritant	Warning only
	Environmental	Warning only

Life cycle toxicity assessment – Supply chain & life cycle impacts

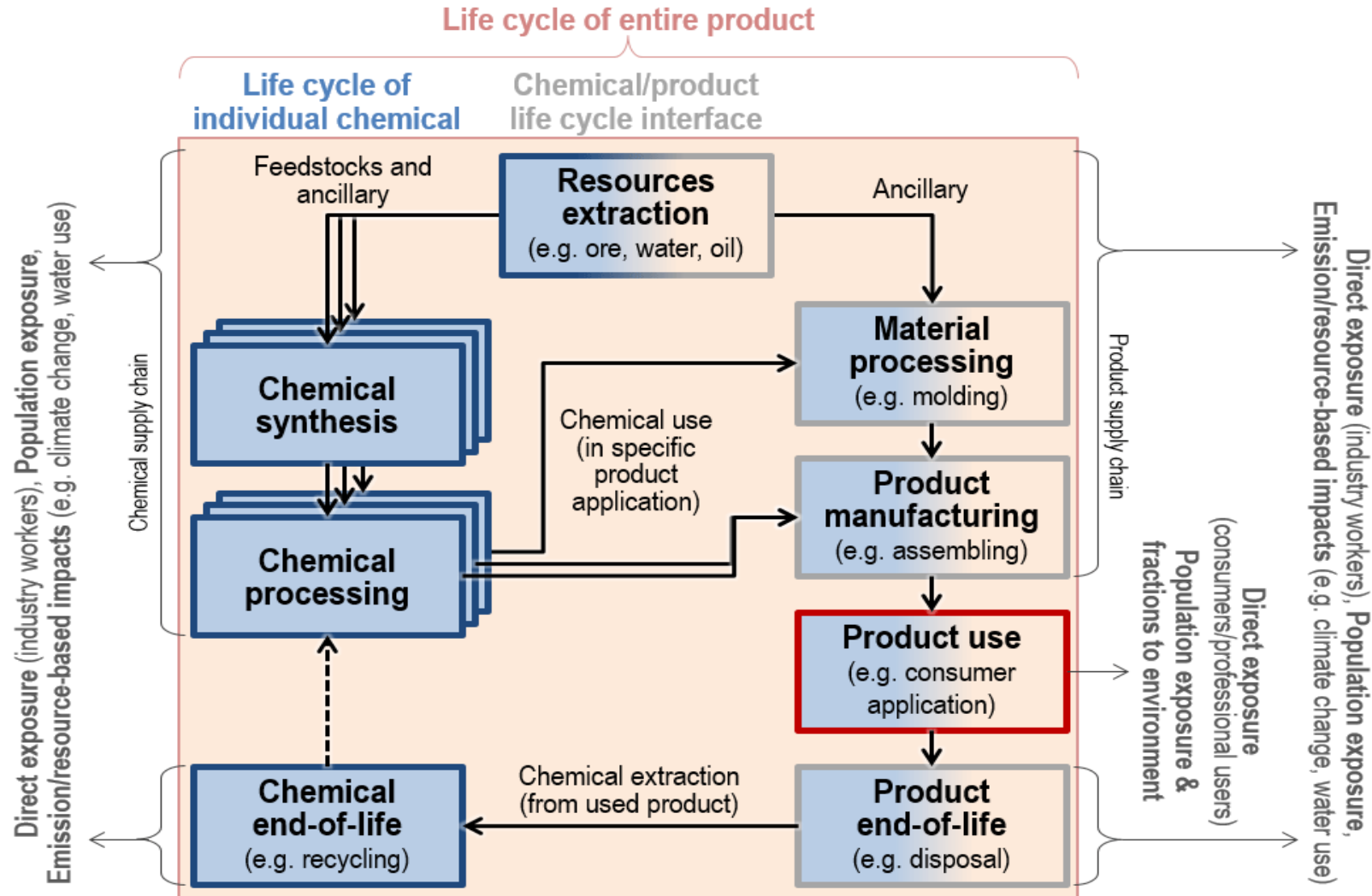


PiF : product intake fraction [kg intake/kg in product], wf : chemical weight fraction in product [kgchemical/kg product], M : product mass applied [kgproduct/functional unit or kgproduct/person/day], n : number of individuals [persons], BW : individual body weight [kg/person], x : effect response level, TD_x : dose inducing level x of tumors [mg/kg_{BW}-d], POD_x : point of departure for deriving a reference dose [mg/kg_{BW}-d], UF : uncertainty factors, m : reactant mass needed in chemical supply chain [kg/functional unit], ef : emission factor per reactant mass [kg/kg], FF : fate factor linking mass in the environment to mass emitted [kg/(kg/d)], XF : exposure factor linking exposure rate or exposure fraction to mass in the environment [(kg/d)/kg or kg/kg], EF : effect factor linking toxicity or ecotoxicity effects to exposure [impact/kg]

Safety & Sustainability in SSbD: A step-wise approach

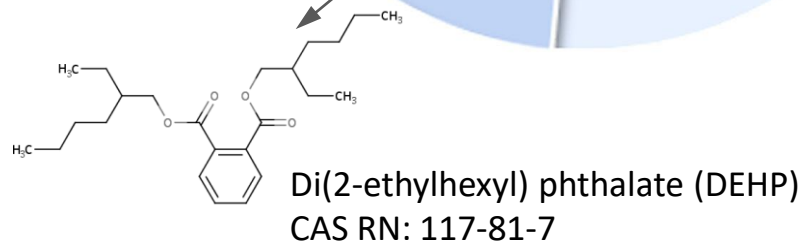
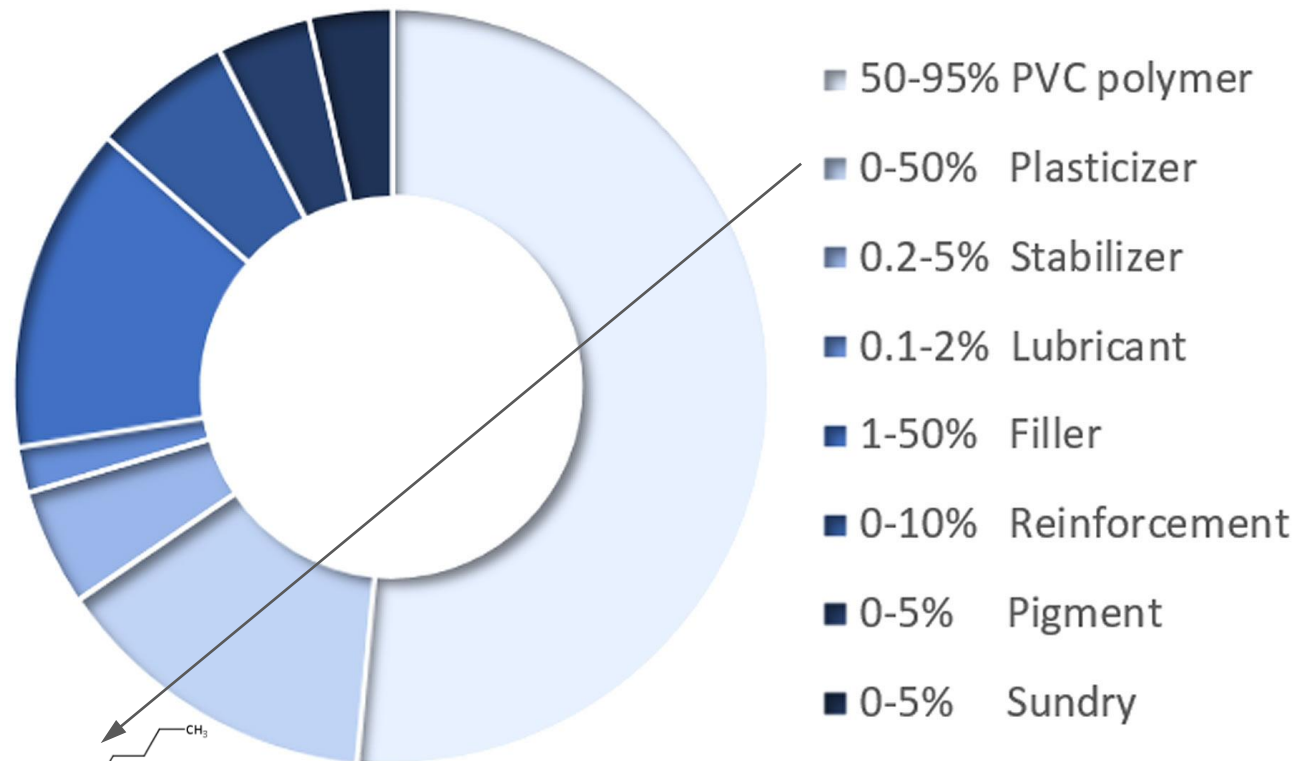
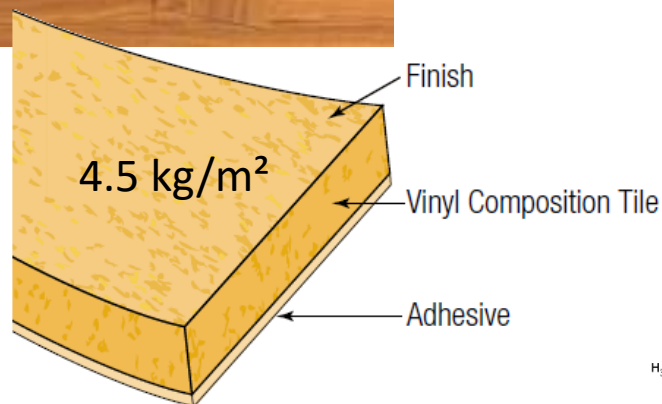


Perspectives and life cycles in USEtox

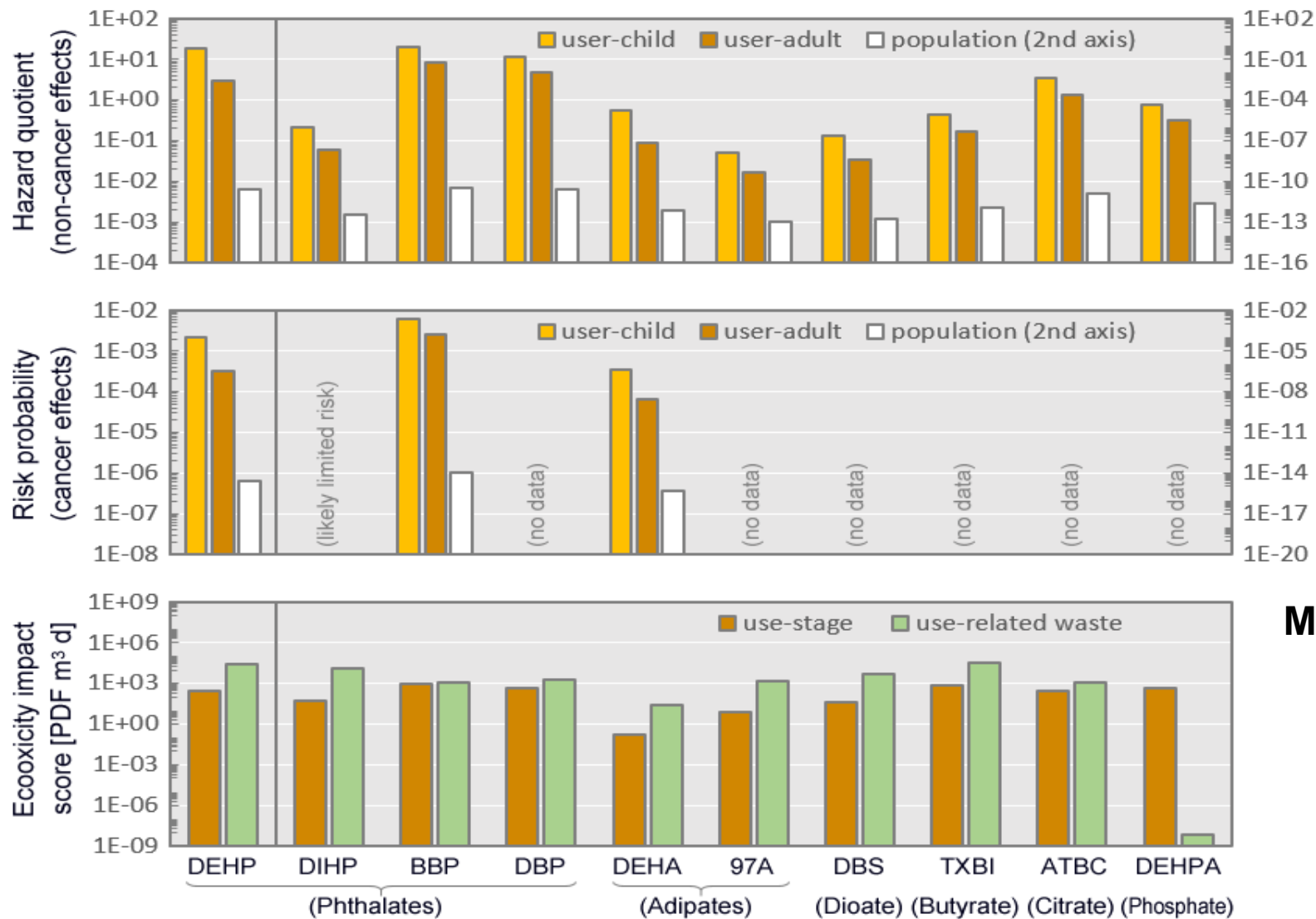


- Emitter vs. receptor perspective
- Chemical vs. product life cycle
- Near-field vs. far-field exposure

Example: DEHP Plasticizer in Vinyl Flooring



Tier 1: Alternative Plasticizers – Use Stage (Safety)



Receptor perspective

USEtox hazard metrics

Effect factors

Fate factor = persistence

Exposure dose

Lifetime cancer risk

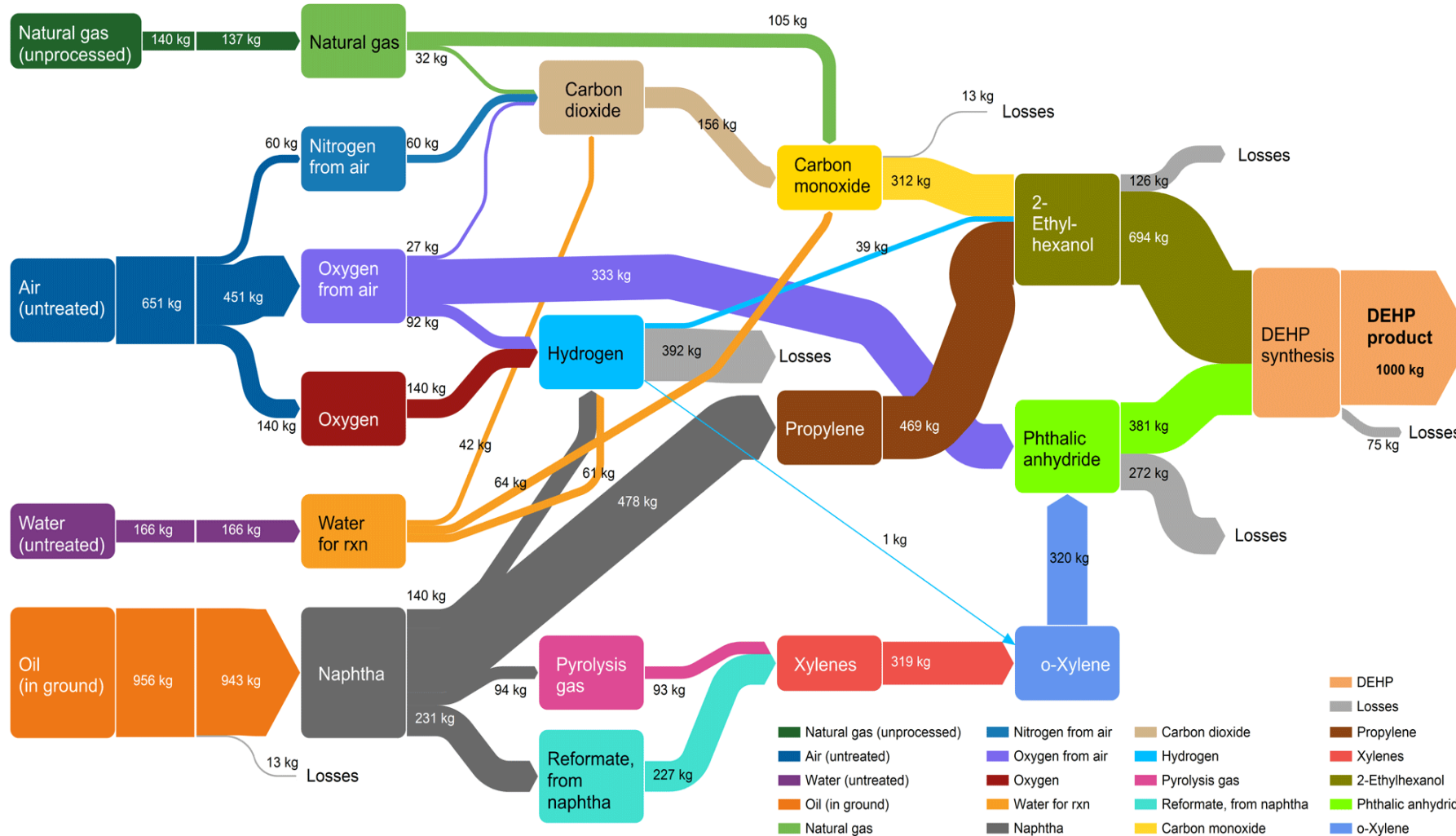
Hazard quotient

Maximum acceptable content

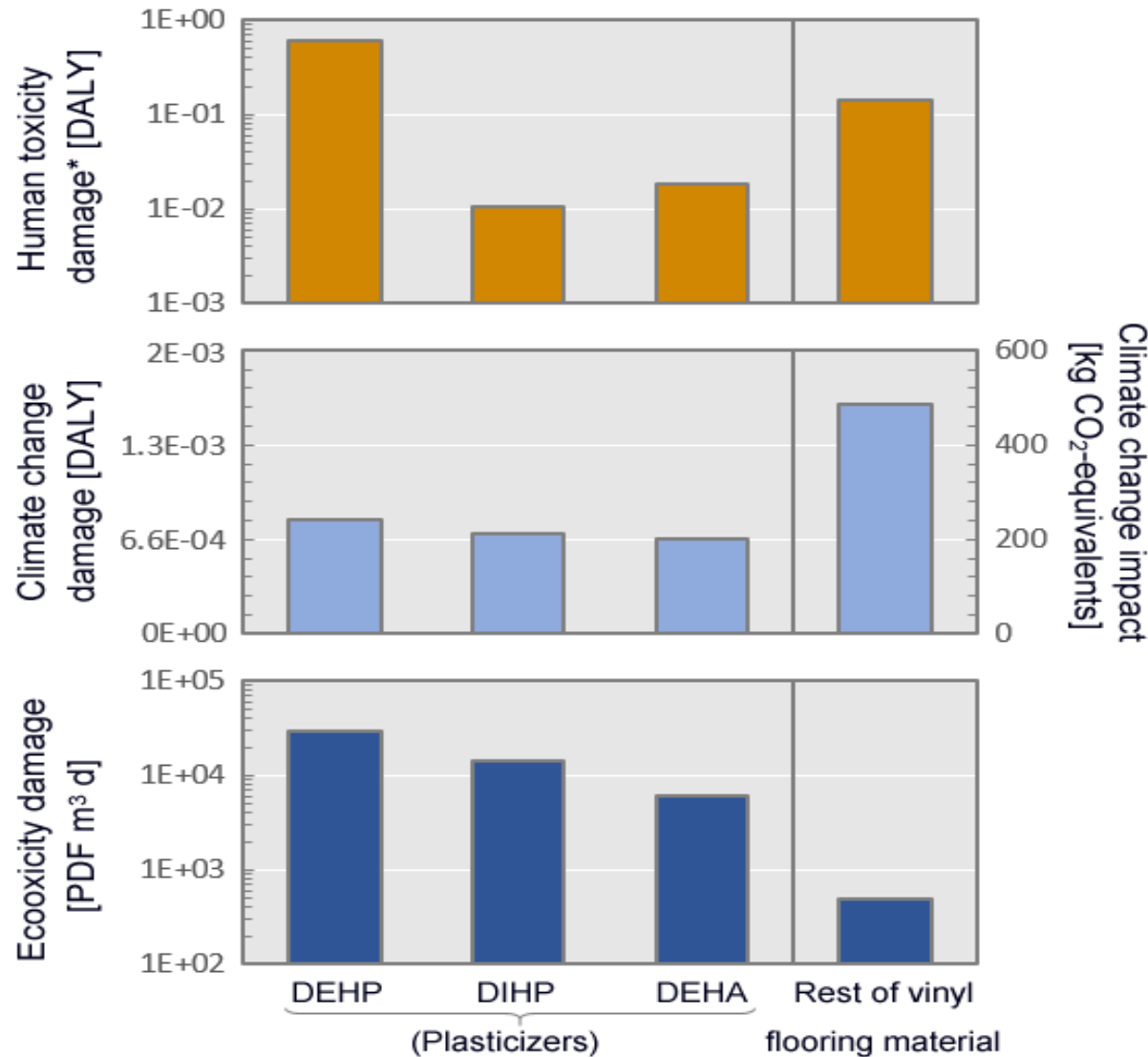
Tier 2: Chemical Supply Chain Information (Sustainability)

Example: natural resources and intermediate products used for producing DEHP

Emitter perspective



Tier 3: Product Life Cycle Screening Impacts (Sustainability)



- Select impact categories based on relevance for SSbD use context
- Not the chemical class, but the function drives impact profiles
- Uncertainties help to understand whether differences are significant
- Rest-of-product contribution varies across indicators

USEtox impact metrics

Characterization factors

Take-Home Messages

- **Safety & sustainability** elements in SSbD can be combined in USEtox for human and ecosystem effects from chemicals, based on same boundary conditions & same foundation for different metrics
- Growing availability of chemical **LCI information** crucial (e.g. EGIP)
- Not only SSbD assessment steps, but also **succession in interpretation** (i.e. aligned (!) broadening of assessment scope)
- **Reference for comparison** at each assessment step relevant (functional comparison unit, and receptor vs. emitter perspective)

Thank you!

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