Summer 2021 Webinar:

Finding Alternatives: Resources, Tools and Strategies Used by Practitioners

Wednesday, June 28, 2021
12:00 PM - 1:00 PM ET

WELCOME!

Today's A4 webinar: **Finding Alternatives: Resources, Tools and Strategies Used by Practitioners**

Goals for today:

- Learn about resources, tools and techniques that alternatives assessment practitioners are using to search for and find substitution options for consideration in an alternatives assessment.
- Learn about the importance of defining the scope of alternatives to be considered.

Know that this is just one of the first steps of an alternatives assessment. Options identified require further evaluation of hazard, exposure potential, cost and performance attributes.

Today's facilitators

Dr. Margaret Whittaker
TOXSERVICES TOXICOLOGY RISK ASSESSMENT CONSULTING
Co-Chair, A4 Program Committee

Lauren Heine
CHEM FORWARD know better chemistry
Co-Chair, A4 Program Committee

Today's Speakers

Anna Montgomery
Northwest Green Chemistry

Elke Van Asbroeck
Apeiron Team

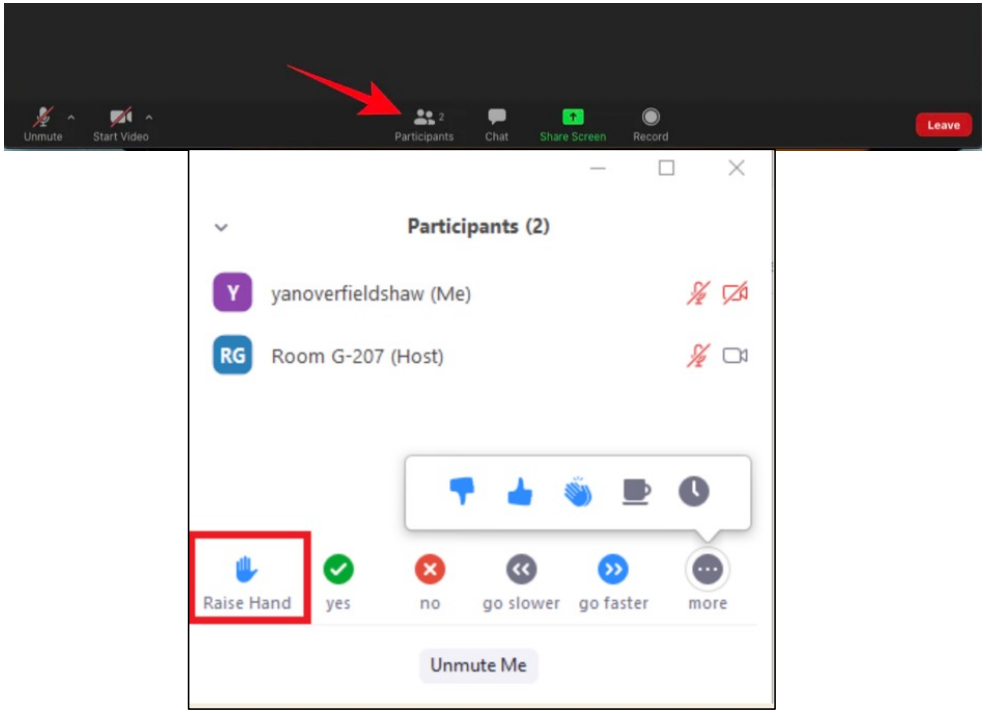
Amelia Nestler
Northwest Green Chemistry

Additional insights from our A4 Community of Practice

Webinar Logistics

- We are using Zoom Meeting. Please keep your lines muted and your videos off.
- Use "**speaker view**" in Zoom – it will offer the best viewing experience.
- During the Q&A portion of the session, if you wish to ask a question or offer a comment, please raise your hand
  - Feel free to unmute your line and turn on your video so engage more voices/faces in the conversation.
  - Also feel free to use the chat.
- This session is being recorded and will be posted with the slide deck on the A4 website: www.saferalternatives.org
- An inventory of resources described on this webinar will also be posted on the A4 website.

We want to hear your insights on resources to find alternatives - Raise your hand in Zoom



- To “raise you hand”
  - first open the participants icon on the bottom of your computer screen
  - When the participants view opens, you’ll find the “raise hand” icon in the icon list at the bottom.
  - Help us by lowering your hand (toggle the icon) when you finished with your question/comment
- The chat will work too

Finding Alternatives: Resources, Tools and Strategies Used by Practitioners

TOPICS IN
ALTERNATIVES ASSESSMENT

Anna Montgomery and Amelia Nestler
Northwest Green Chemistry

https://uml.zoom.us/j/95847245035

Finding Alternatives: Resources, Tools, and Strategies Used by Practitioners

Amelia Nestler, Ph.D.
Senior Environmental Scientist &
Anna Montgomery, M.P.A., Ed.D.
Executive Director of
Northwest Green Chemistry

Northwest Green Chemistry

ASSOCIATION FOR THE ADVANCEMENT OF ALTERNATIVES ASSESSMENT

Strategies

Promising Practices

- Actively engage stakeholders
- Enhance the decision framework using a selection guide approach
- Scope alternatives broadly
- Optimize ingredient transparency
- Identify data gaps

Problem definition and scoping

- Technology survey
- Function evaluation (avoid over-engineering)

Literature review (include grey)

Expert interviews, focus groups, technical working groups

Multi-attribute: Sustainable products support a circular economy, incorporate life-friendly chemistry, restore natural capital, and support social and environmental justice

Consensus: Broad design principles and parameters that are flexible, but meaningful

Transparency: In principles, tools, and formulation; allows for fair comparisons

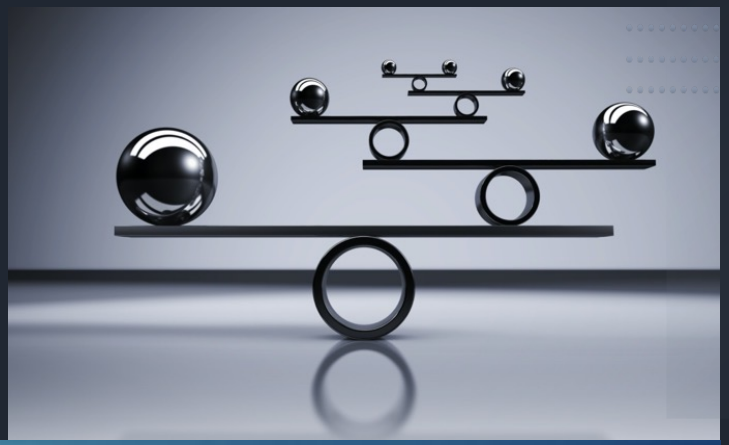
Data gaps: Highlights uncertainty alongside known problem areas

Assessment: Allows user to compare existing and new products

https://www.northwestgreenchemistry.org/news/beta-testing-prism

Tools: (1) Chemical Inventory (2) Chemical Hazard Assessment (3) Exposure Assessment (4) Stakeholder Considerations (5) Social & Environmental Justice (6) Life Cycle Considerations (7) Decision Analysis

Context Matters for Strategy



Smart & Evidence-Based Practices

Stakeholder Engagement

- Engage stakeholders early
- Target messages to different audiences
- Establish a collaboration champion
- Utilize a trusted facilitator
- Establish trust
- Utilize collaborative governance
- Use collaboration and communication management software
- Ensure strong collaboration leadership
- Determine stakeholder motivations

Intersectoral Collaboration

- Identify purpose & goals of collaboration
- Define roles and responsibilities
- Determine actions collaboration will take
- Establish commitment among collaborators
- Identify shared motivation
- Address intellectual property concerns
- Engage inclusive & diverse stakeholders
- Develop legitimacy for the intersectoral effort
- Agree upon and set ground rules for all
- Engage in ongoing dialogue
- Address power imbalances
- Exhibit & share leadership
- Support accountability
- Define success
- Build Trust

Resources

OECD Substitution and Alternatives Assessment Toolbox (SAAT)

- Alternative assessment frameworks and guides
- Case studies, toolkits, and product rating systems
- Regulations and restrictions

Material circularity indicator & circular design guide from Ellen MacArthur Foundation (identify circular value of product and evaluate a range of environmental, regulatory, and supply chain risks)

Tools

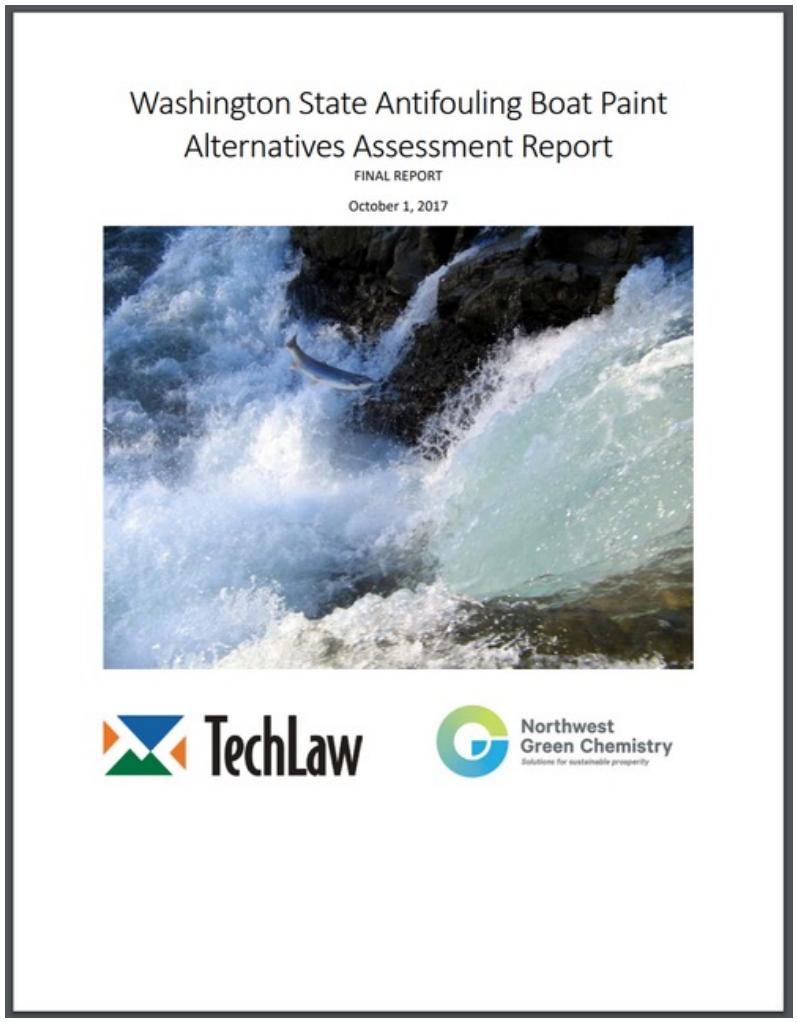
Chemical hazard assessment tool selector with filter

Non-hazard assessment tools (cost/benefit and availability, exposure assessment, materials management, etc.)

INEMI Reuse and Recycling Metrics (electronics)

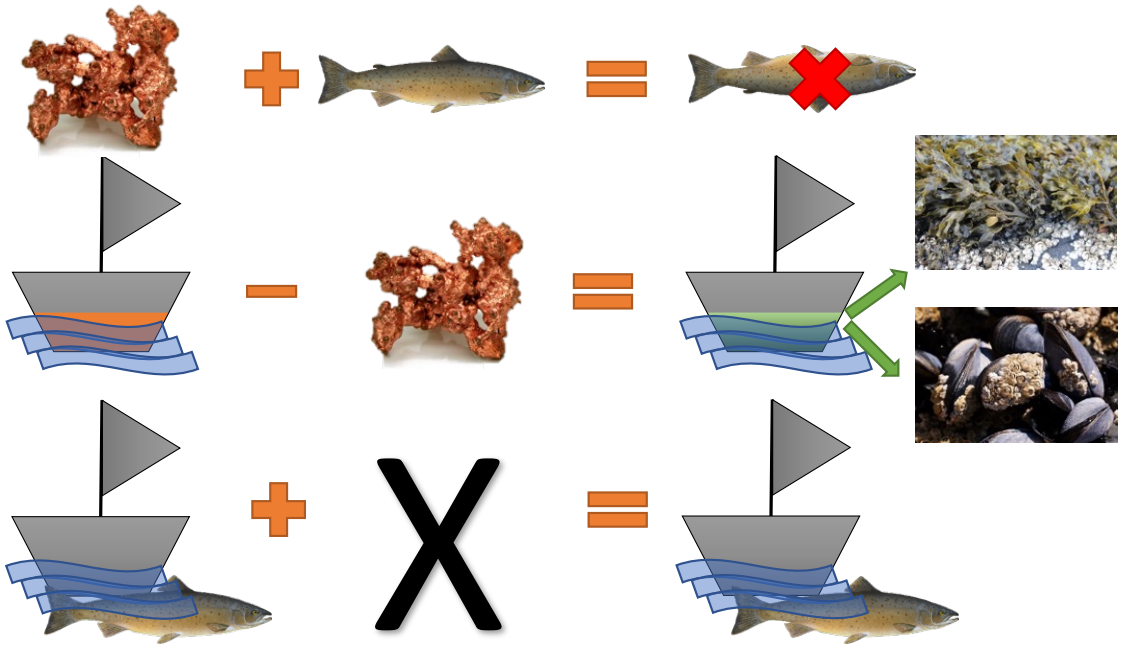
Software: Moldflow & Fusion 360 (Autodesk) Sphera

Safety & sustainability certifications

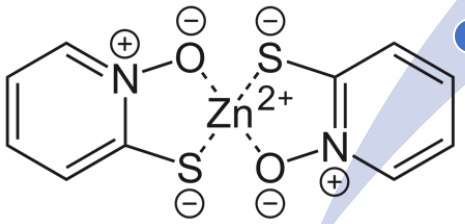


Download from our website: **https://bit.ly/NGCBoatPaint**

Or go to www.northwestgreenchemistry.org and go to the "Resources" heading, then "Publications".



What kind of alternatives are in scope?



Other biocides

Other biocidal paints

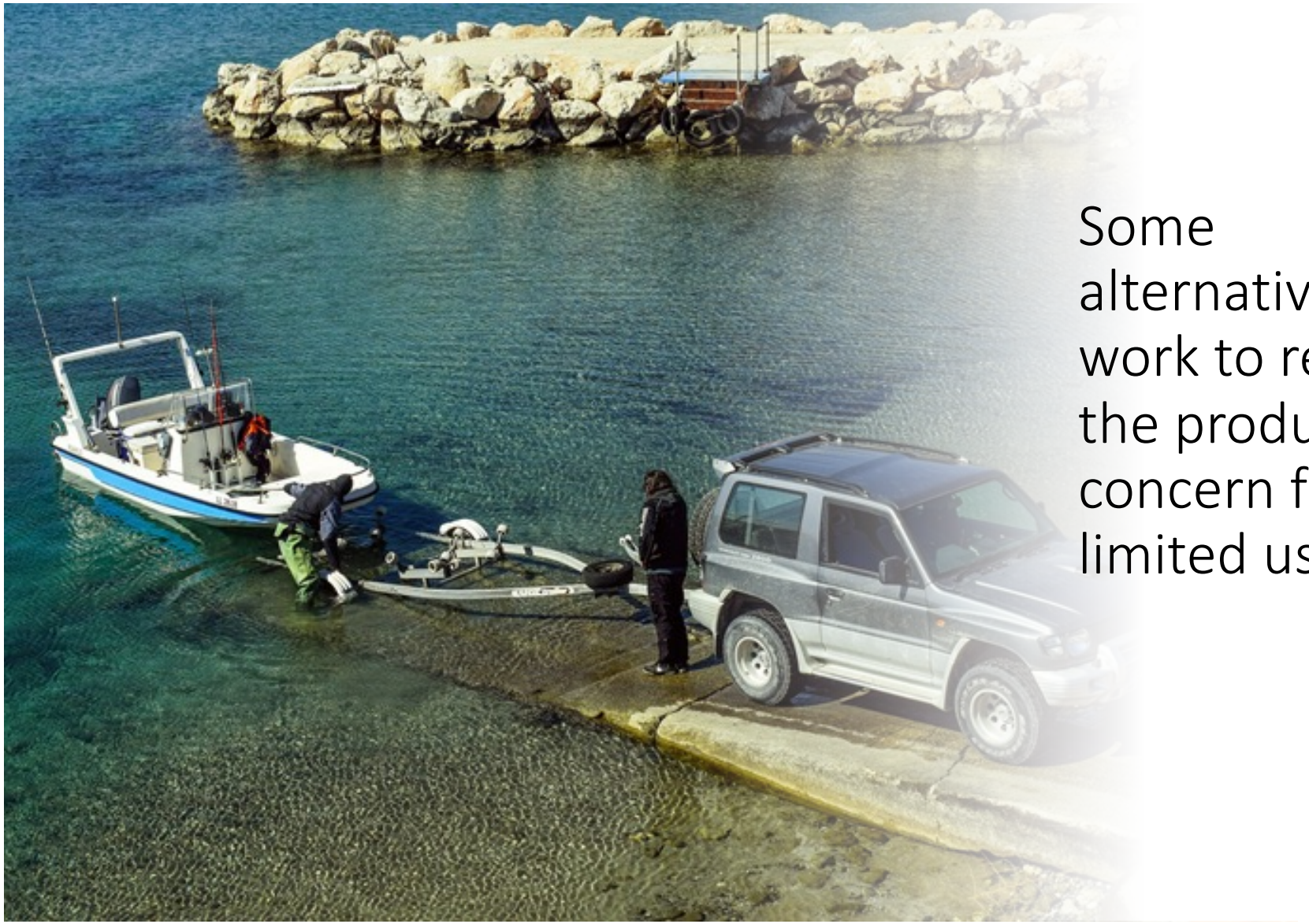
Non-biocidal paints

Non-coating solutions

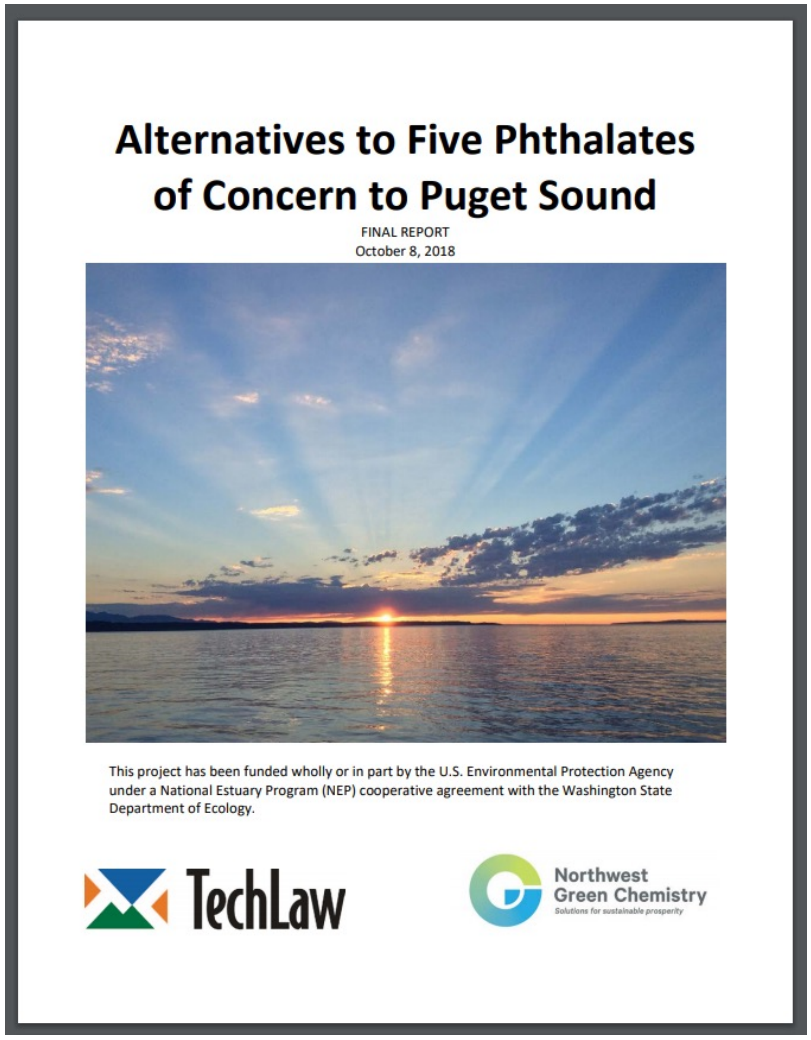
Marina-wide solutions

What sources did we use to identify potential alternatives?

- Product-specific database (e.g. pesticide registration)
- Vendor websites
- Conferences, conventions & expos
- Interviews

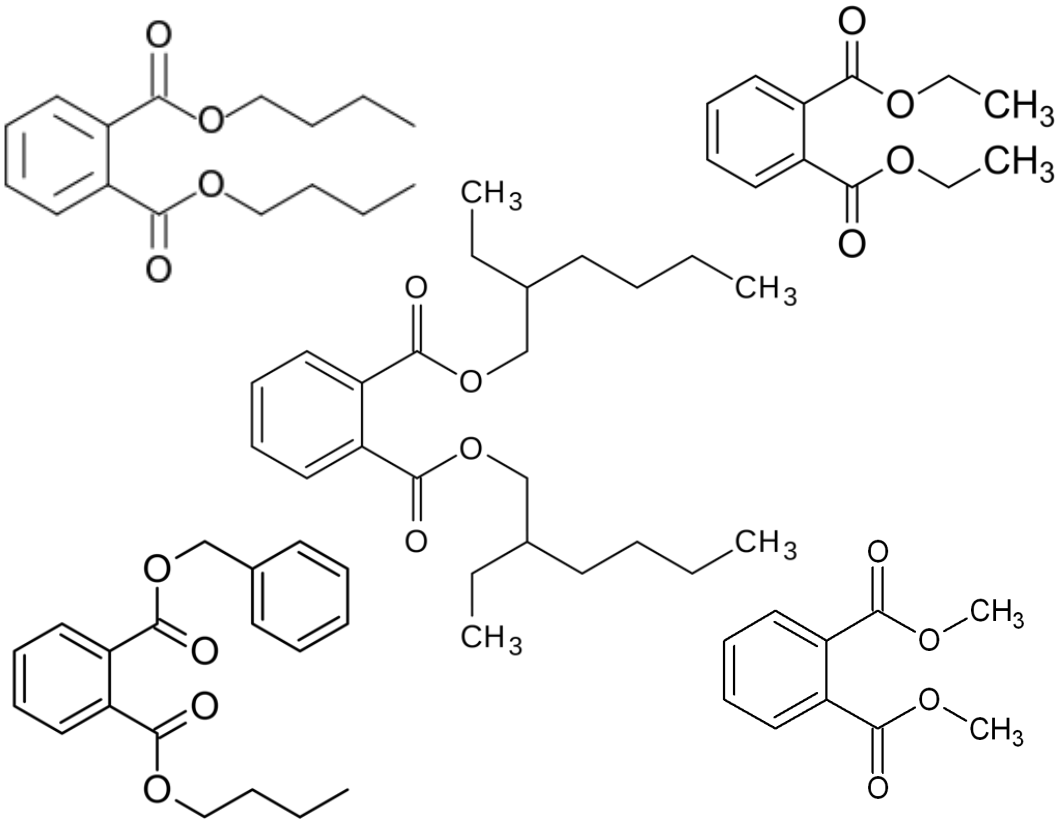


Some alternatives only work to replace the product of concern for limited use cases

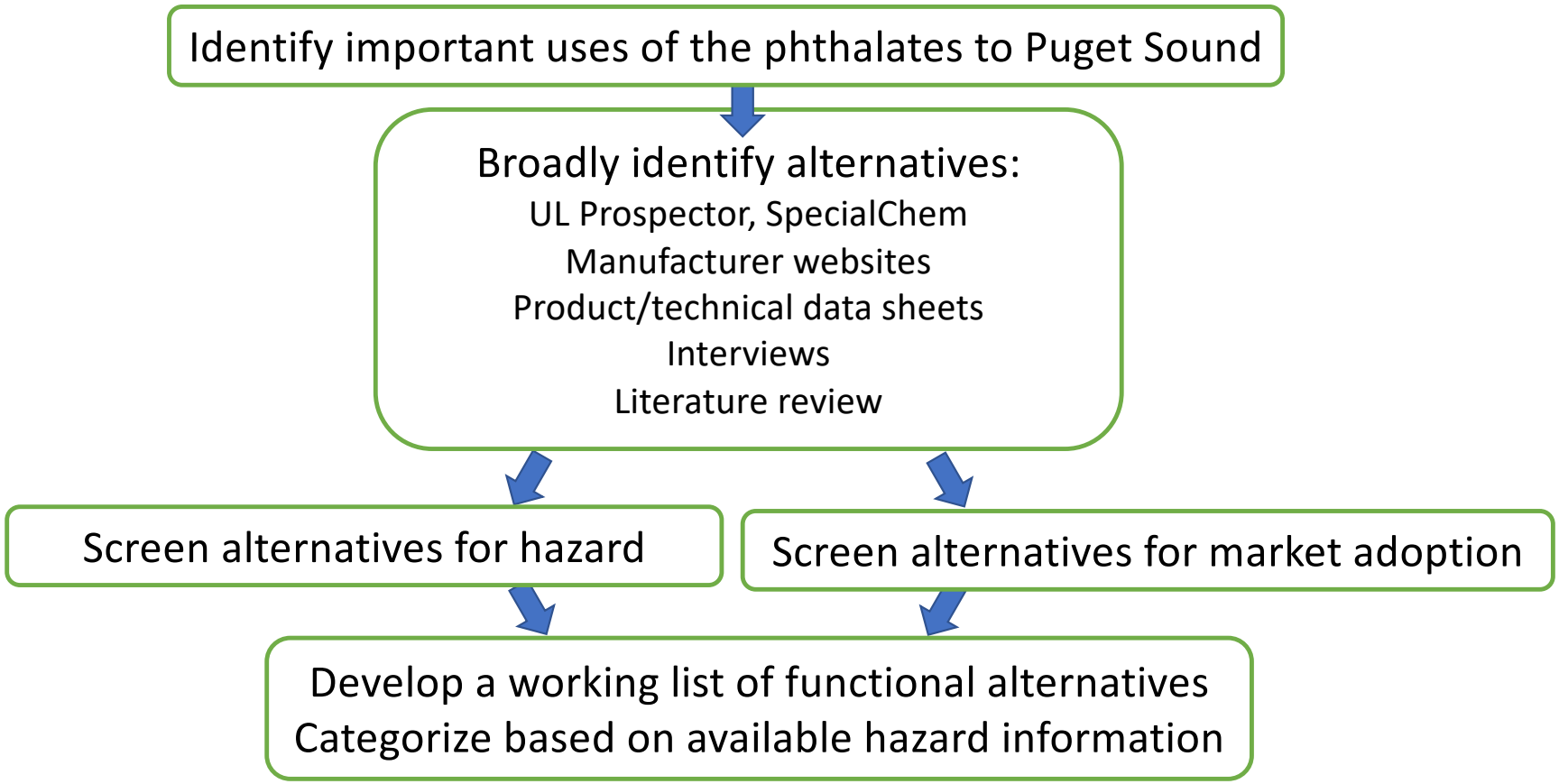


Download from our website: **http://bit.ly/NGCPhth**

Or go to www.northwestgreenchemistry.org and go to the "Resources" heading, then "Publications".

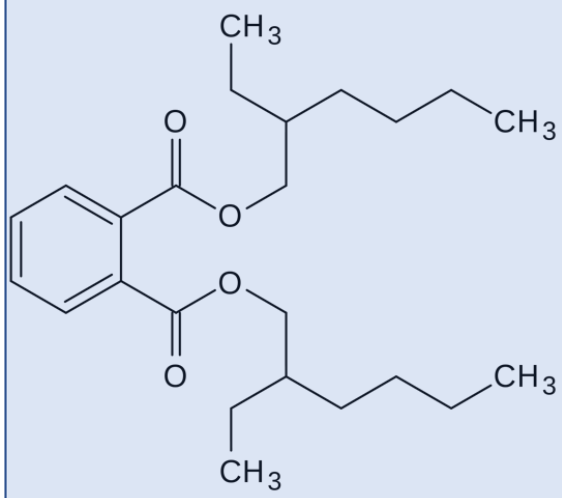


Our approach to identify inherently less hazardous, functional alternatives to the five phthalates



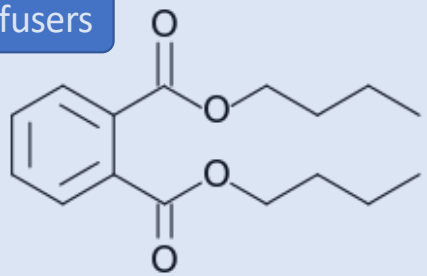
Phthalates used as plasticizers and fast fusers

Plasticizers and fast fusers



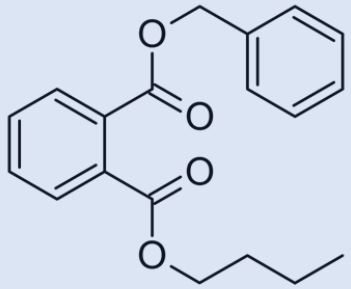
DEHP

Bis(2-ethylhexyl) phthalate



DBP

Dibutyl phthalate



BBP

Butylbenzyl phthalate

Resources used for finding alternatives

Detailed hazard profiles included

- ChemForward: https://www.chemforward.org/
  - Will still publish profiles of hazardous chemicals

Some hazard or sustainability criteria

- US EPA Safer Chemicals Ingredients List (SCIL): https://www.epa.gov/saferchoice/safer-ingredients
  - CleanGredients: https://cleangredients.org/
- TCO Certified Accepted Substances List: https://tcocertified.com/accepted-substance-list/
- ChemSec Marketplace: https://marketplace.chemsec.org/

No/minimal hazard criteria for listing

- UL Prospector: https://www.ulprospector.com/en/na
- SpecialChem: https://www.specialchem.com
- Pharos: https://pharosproject.net/

Unknown/Varied Criteria

- Literature searches
- Vendor websites
- Interviews

Full list of potential alternative plasticizers/fast fusers

- Dipropylene glycol dibenzoate (CAS# 27138-31-4)
- Triacetin (CAS# 102-76-1)
- Acetylated monoglycerides derived from fully hydrogenated castor oil (CAS# 736150-63-3, COMGHA)
- Bis (2-ethylhexyl) terephthalate (CAS# 6422-86-2, DEHT)
- Diisononyl cyclohexanedicarboxylate (CAS# 166412-78-8 and 474919-59-0, DINCH)
- Dibutylterephthalate (CAS# 1962-75-0, DBT)
- Tris (2-ethylhexyl) trimellitate (CAS# 3319-31-1, TOTM)
- 2-ethylhexyl adipate (CAS# 103-23-1, DEHA)
- Acetyl tributyl citrate (CAS# 77-90-7, ATBC)
- Diisononyl adipate (CAS# 33703-08-1, DINA)
- Epoxidized soybean oil (CAS# 8013-07-8, ESBO)
- Pentaerythritol tetravalerate (CAS# 15834-04-5)
- Alkylsuphonic phenyl ester (CAS# 91082-17-6, ASE)
- Methyl esters of epoxidized soybean oil fatty acids (CAS# 68082-35-9)
- Diethylene glycol dibenzoate (CAS# 120-55-8)
- Di (2-propylheptyl) phthalate (CAS# 53306-54-0, DPHP)
- Diocty Phthalate (CAS# 117-84-0, DNOP)
- diundecyl phthalate (CAS# 3648-20-2, DUP)
- Di-2-ethylhexyl azelate (CAS# 103-24-2, DOZ)
- Di-butyl adipate (CAS# 105-99-7, DBA)
- Di-butyl sebacate (CAS# 109-43-3, DBS)
- Triethylene glycol dibenzoate (CAS# 120-56-9)
- Isosorbide Diesters (CAS# 1215036-04-6)
- Butylated hydroxytoluene (CAS# 128-37-0, BHT)
- Dioctyl sebacate (CAS# 122-62-3, DOS)
- Acetyltri-n-hexyl citrate (CAS# 24817-92-3, ATHC)
- Di-isodecyl sebacate (CAS# 28473-19-0, DIDS)
- Di(2-ethylhexyl) phosphate (CAS# 298-07-7, DEHPA)
- Isodecyl benzoate (CAS# 131298-44-7)
- Isononyl Benzoate (CAS# 670241-72-2)
- Propylene glycol dibenzoate (CAS# 19224-26-1)
- Di(butoxyethoxyethoxyethtyl) glutarate (CAS# 65520-42-5)
- Epoxidized soybean fatty acid (CAS# 68082-34-8)
- 2,2,4-trimethyl-1,3 pentanediol diisobutyrate (CAS# 6846-50-0, TPIB, TXIB)
- 1,2,4-Benzenetricarboxylic acid, tri-C7-9-branched and linear alkyl esters (CAS# 68515-60-6)
- Epoxidized propylene glycol dioleate (CAS# 68609-92-7)
- Tributyl Trimellitate (CAS# 1726-23-4)
- Acetyl triethyl citrate (CAS# 77-89-4)
- Tributyl Citrate (CAS# 77-94-1)
- Tri(2-ethylhexyl) phosphate (CAS# 78-42-2, TEHPA)
- Epoxidized linseed oil (CAS# 8016-11-3)
- n-Butyryltri-n-hexyl Citrate (CAS# 82469-79-2)
- o-toluene sulfonamide (CAS# 88-19-7, OTSA)
- Trioctyl trimellitate (CAS# 89-04-3)
- 1,2,4-Benzenetricarboxylic acid, mixed decyl and hexyl and octyl esters (CAS# 68130-50-7)
- Hexanedioic acid, polymer with 2,2-dimethyl-1,3-propanediol and 1,2-propanediol, isononyl ester (CAS# 208945-13-5)
- Adipic acid and polyhydric alcohols (CAS# 208945-12-4)
- Naphthenic Hydrocarbon (CAS# 64742-53-6)
- Diisononyl phthalate (CAS# 68515-48-0, DINP-1; CAS# 28553-12-0, DINP-2 and DINP-3)
- Diisodecyl phthalate (CAS# 26761-40-0, DIDP)
- Diisobutyl Phthalate (CAS# 84-69-5, DIBP)
- Diisoheptyl phthalate (CAS# 71888-89-6, DIHP)
- Diisodecyl phthalate (CAS# 68515-49-1, DIDP)
- Tricresyl Phosphate or Tritolyl Phosphate (CAS# 1330-78-5, TCP)

Working List: Alternatives for Plasticizers/Fast Fusers

A

Diisononyl cyclohexanedicarboxylate (DINCH, D9NCH)
Bis (2-ethylhexyl) terephthalate (DEHT, DOTP)

B

Triacetin (GTA)
Acetylated monoglycerides derived from fully hydrogenated castor oil (COMGHA)
Dipropylene glycol dibenzoate

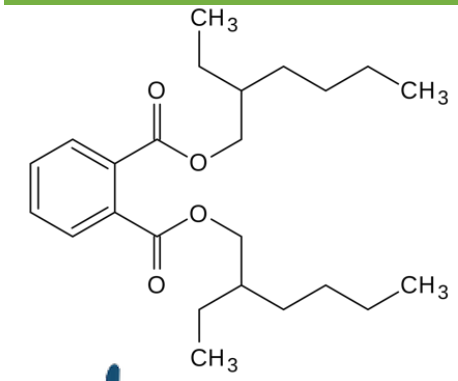
C

Epoxidized soybean oil (ESBO)
Acetyl tributyl citrate (ATBC)
Diisononyl adipate (DINA)
2-ethylhexyl adipate (DEHA, DOA)
Pentaerythritol tetravalerate
Dibutylterephthalate (DBT)
Methyl esters of epoxidized soybean oil fatty acids
Alkylsuphonic phenyl ester (ASE)
Di(2-propylheptyl) phthalate (DPHP)
Tris (2-ethylhexyl) trimellitate (TOTM, TEHTM)
Diethylene glycol dibenzoate (DEGD)

Substitution requires troubleshooting

Left, madame.furie, https://www.flickr.com/photos/madame_furie/2505664126
Right, Pattie, https://www.flickr.com/photos/piratealice/4009205963z

Thank you!



Northwest Green Chemistry

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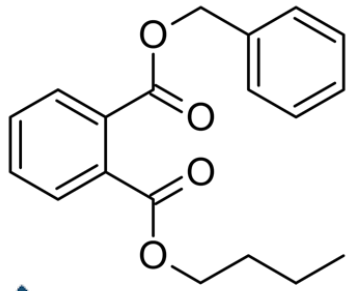
Amelia Nestler, Ph.D. anestler@nwgchem.org

Download the phthalate report: http://bit.ly/NGCPhth

Download the boat paint report: https://bit.ly/NGCBoatPaint



Finding Alternatives: Resources, Tools and Strategies Used by Practitioners

TOPICS IN
ALTERNATIVES ASSESSMENT

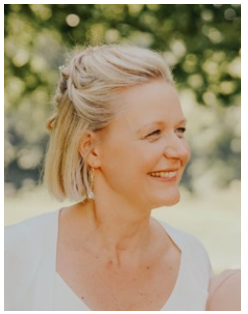
Elke Van Asbroeck
Aperion Team NV

INSPIRATION
for Alternatives Assessment

Elke Van Asbroeck

28 June 2021

Create Positive Impact



1993
Bioscience & Environmental Engineering

1998
Waste & Recycle industry

2001
Polymer Industry

2009
Founded Apeiron

2013
first Apeiron AfA

11 yrs in industry

11 yrs Apeiron

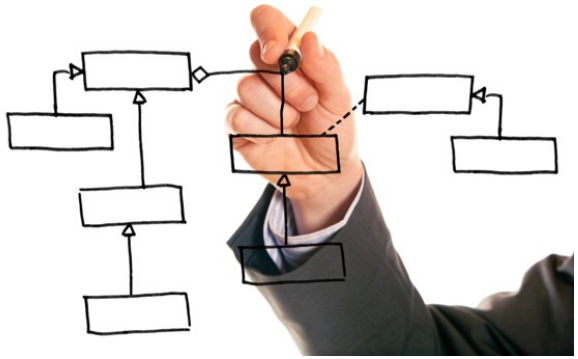
DRIVING THE TRANSITON

Starting from safe use of chemicals,
Apeiron guides its clients to
sustainable, **future proof** business operations.

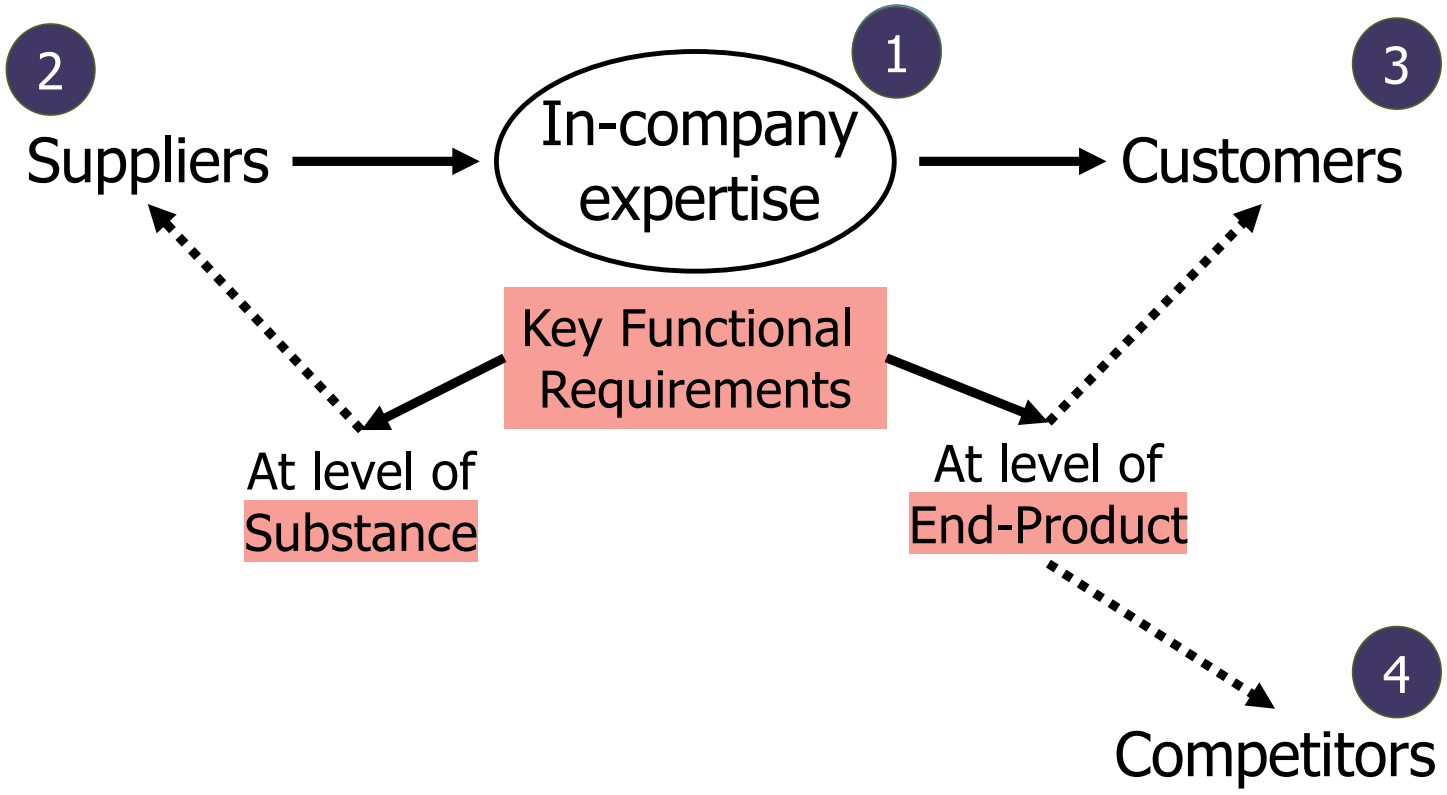
Alternatives Assessment

How do I **start**?

Where do I find **inspiration**?



Key Functional Requirements



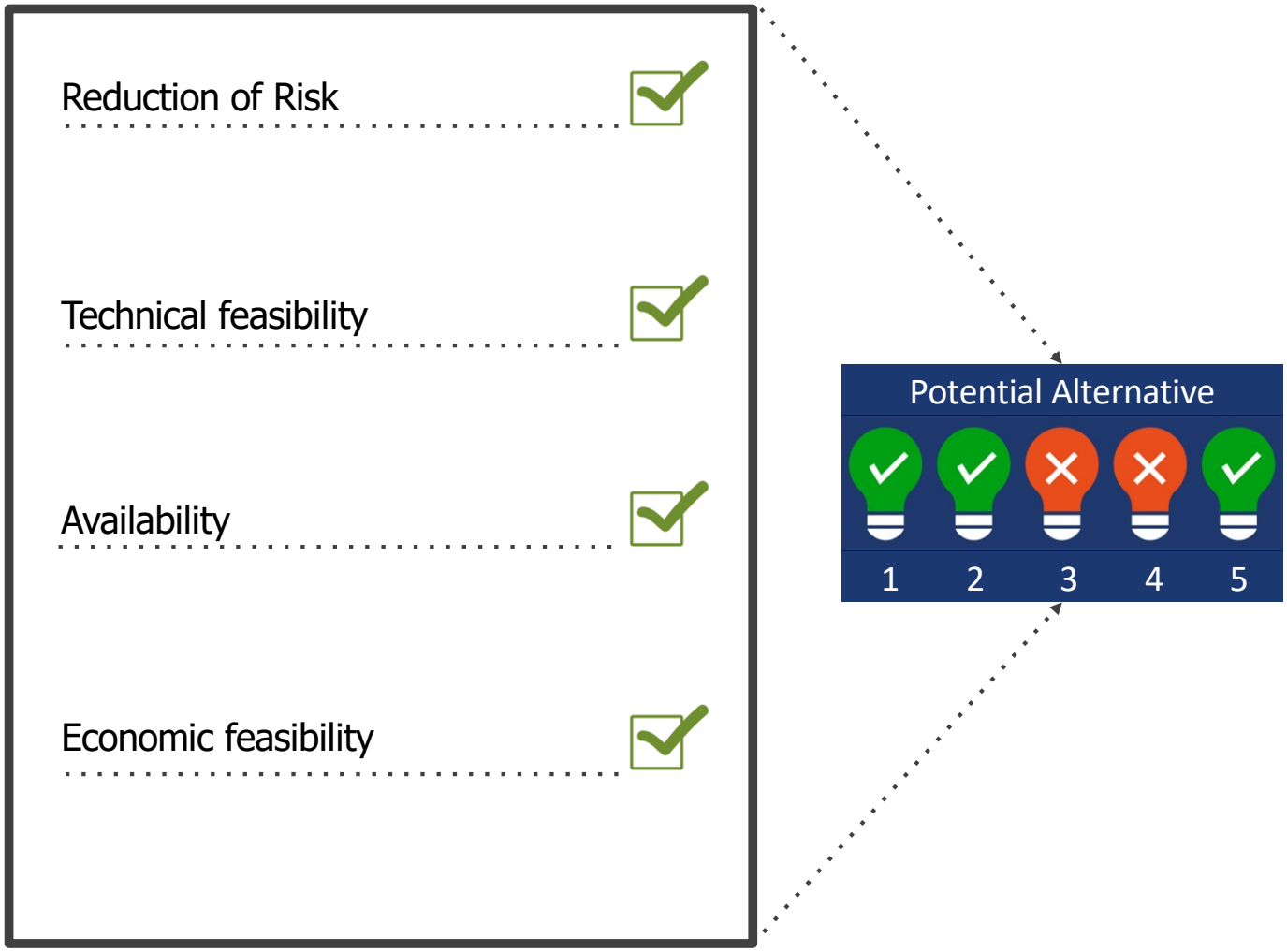
5 Google

6 Dbases (WIPO Green, Market Place, Chemycal,…)

7 Green Chem. Conferences & collaborations with universities

Sources

- **REACH Applications for Authorisation (!!!)**: https://echa.europa.eu/applications-for-authorisation-previous-consultations
- Toxics Use Reduction Institute: https://www.turi.org
- Sweden – Centre for Chemical Substitution: https://www.ri.se/en/centre-chemical-substitution
- WIPO Green: https://wipogreen.wipo.int/wipogreen-database/database?gclid=Cj0KCQjw5uWGBhCTARIsAL70sLJSQX49txAJnrNcQsf9GPNLouhvUpq9MRIN1bs3hjrHi02vAbgnxzQaAoCYEALw_wcB
- EU Member State Initiatives, e.g. BAUA (Germany): https://www.baua.de/EN/Tasks/Research/Research-projects/f2259.html
- SUBsport dbase: https://www.subsportplus.eu/subsportplus/EN/Home/Home_node.html
- Chemsec (NGO) Marketplace: https://marketplace.chemsec.org/
- US-EPA Safer Choice: https://www.epa.gov/saferchoice/design-environment-alternatives-assessments
- Chemycal (check global regulatory actions for alternatives): https://chemycal.com

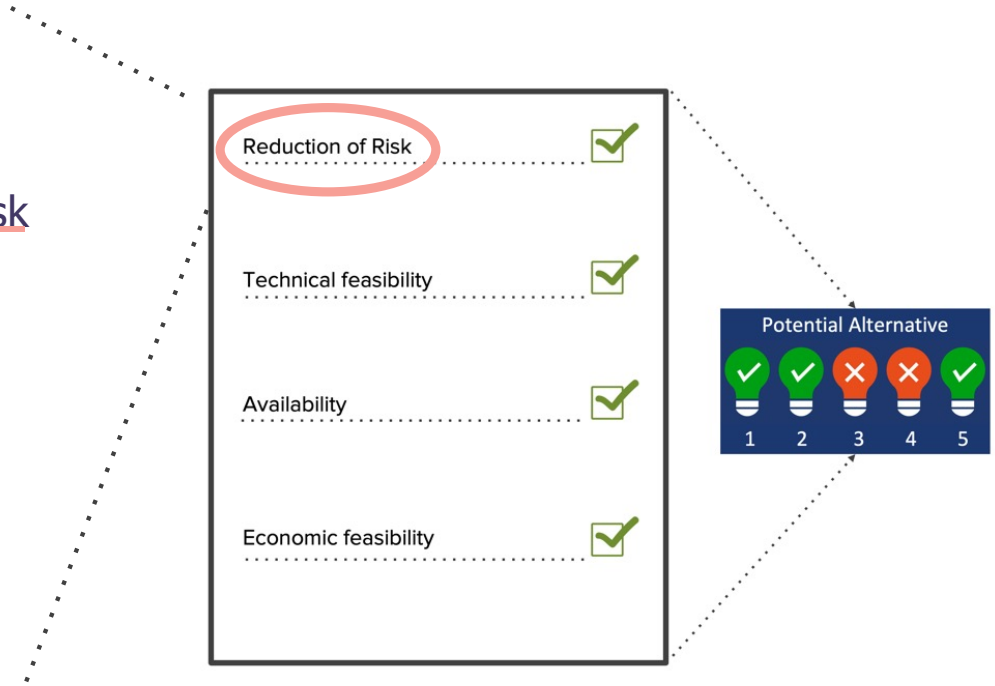


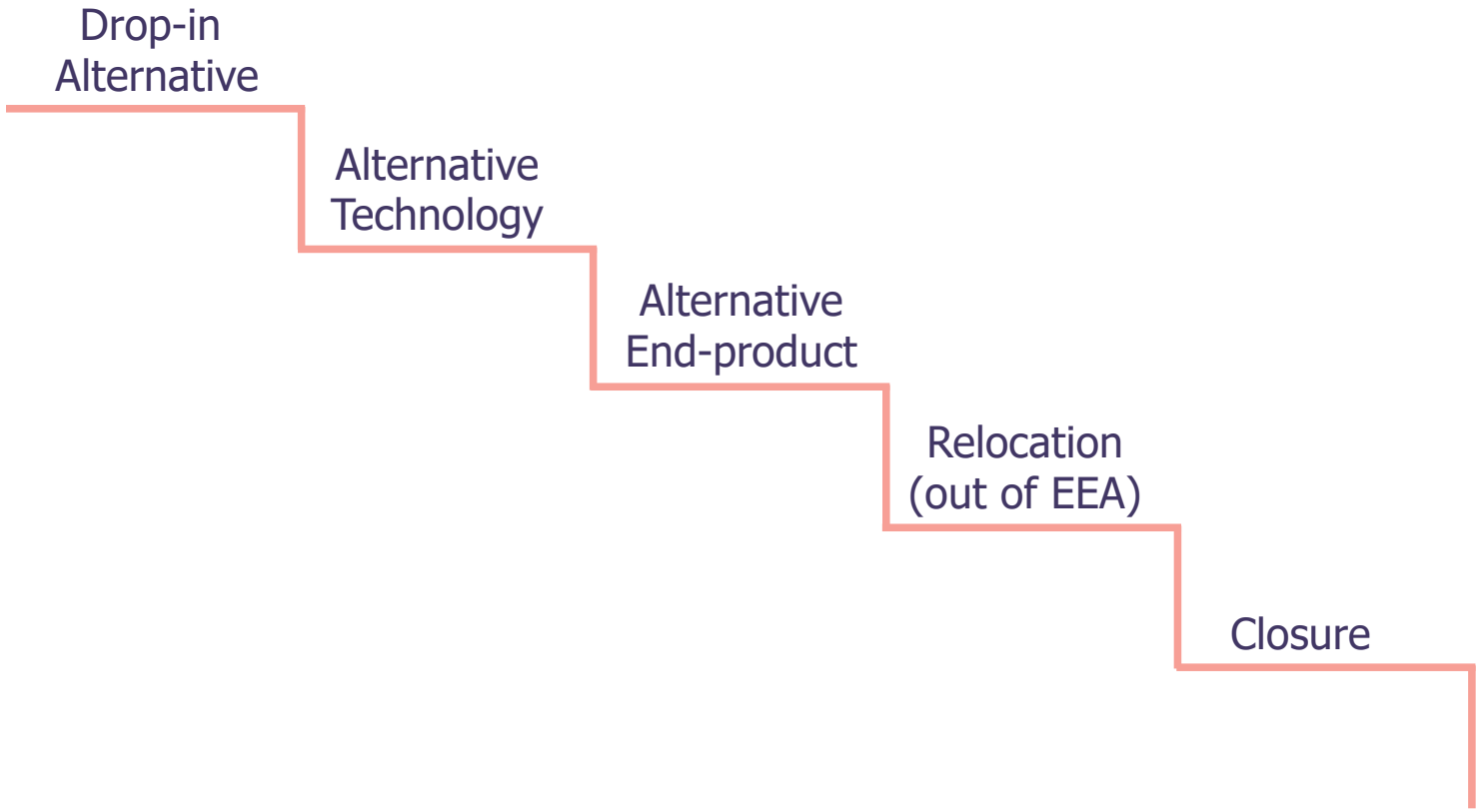
the AoA is company and business dependent

Comparative Risk Assessment

on Toxicity & HH/ENV Health Risk
on Climate
on Circularity
on Resource Depletion

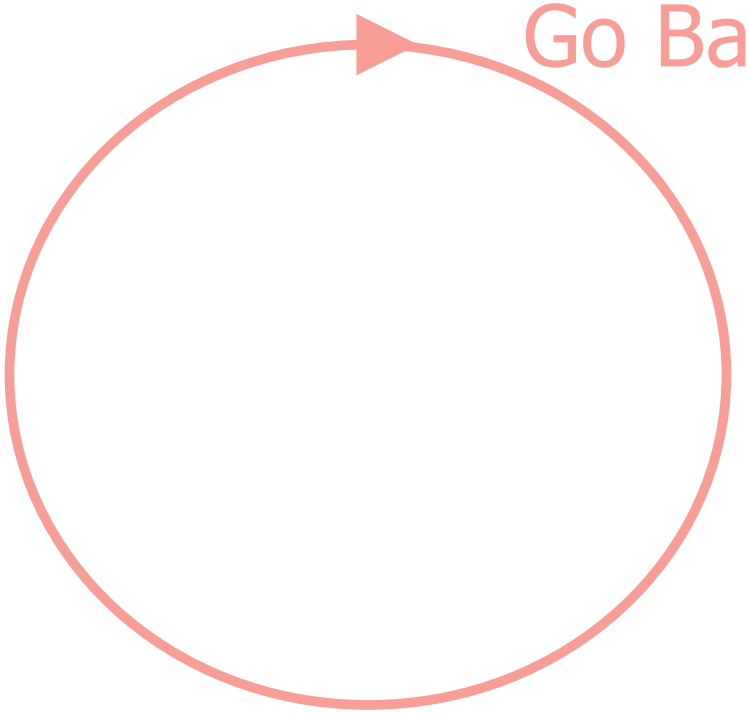
for the entire life cycle
→Avoiding regrettable substitution

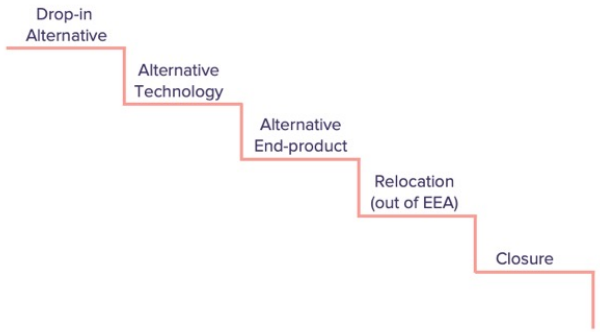



Drop-in Alternative
Alternative Technology
Alternative End-product
Relocation (out of EEA)
Closure

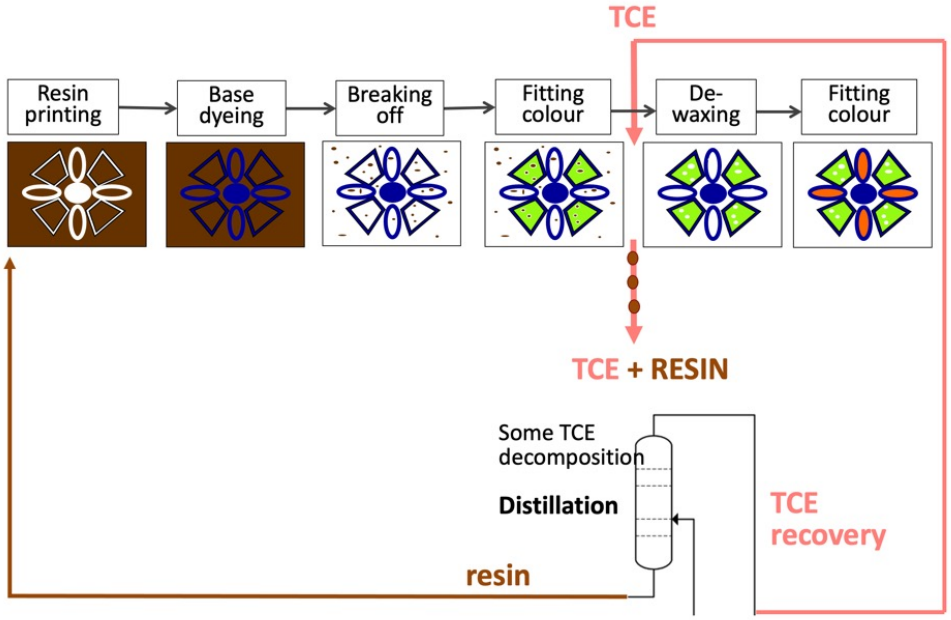
AA is an Iterative Process

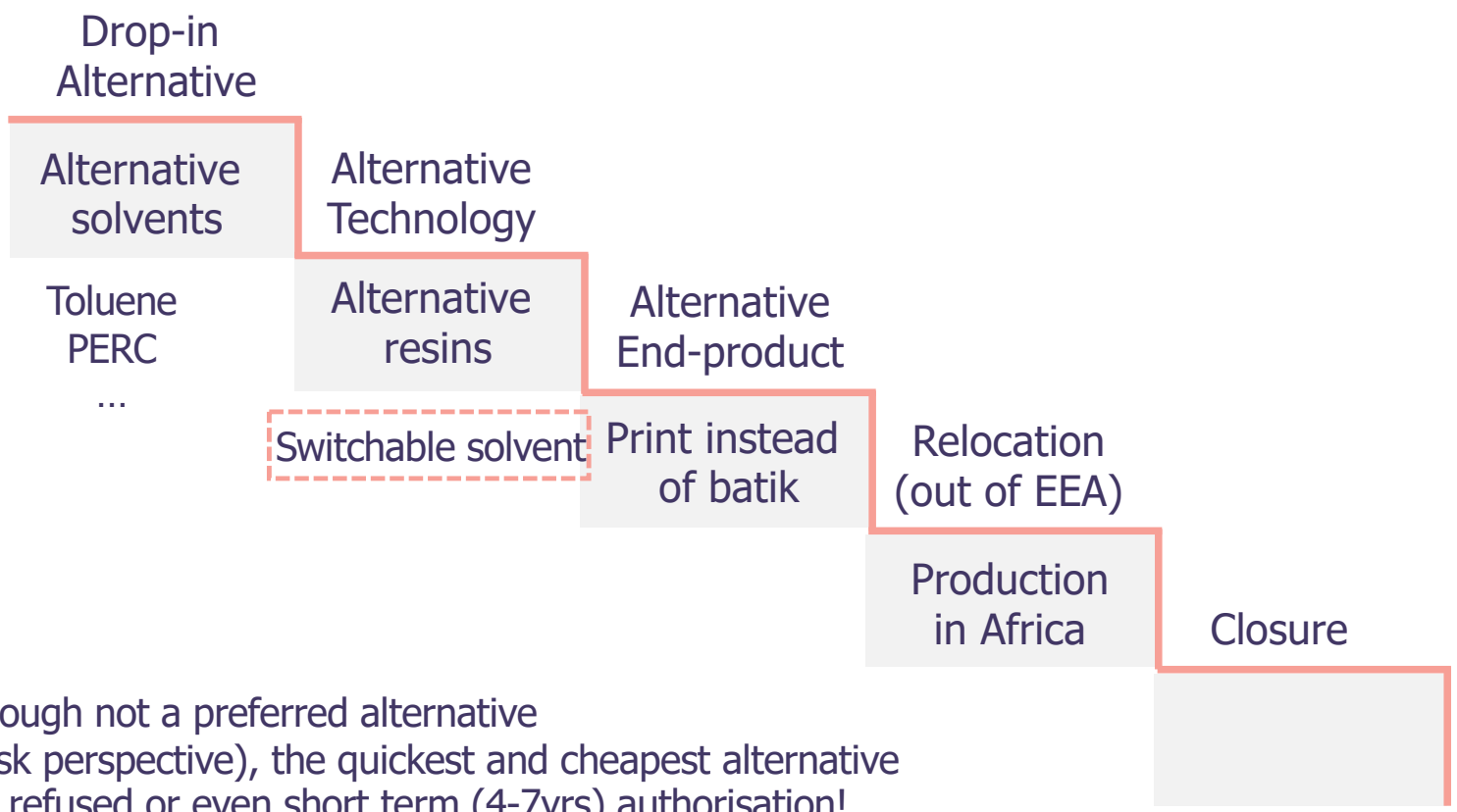
Go Back to Start …





Trichloroethylene

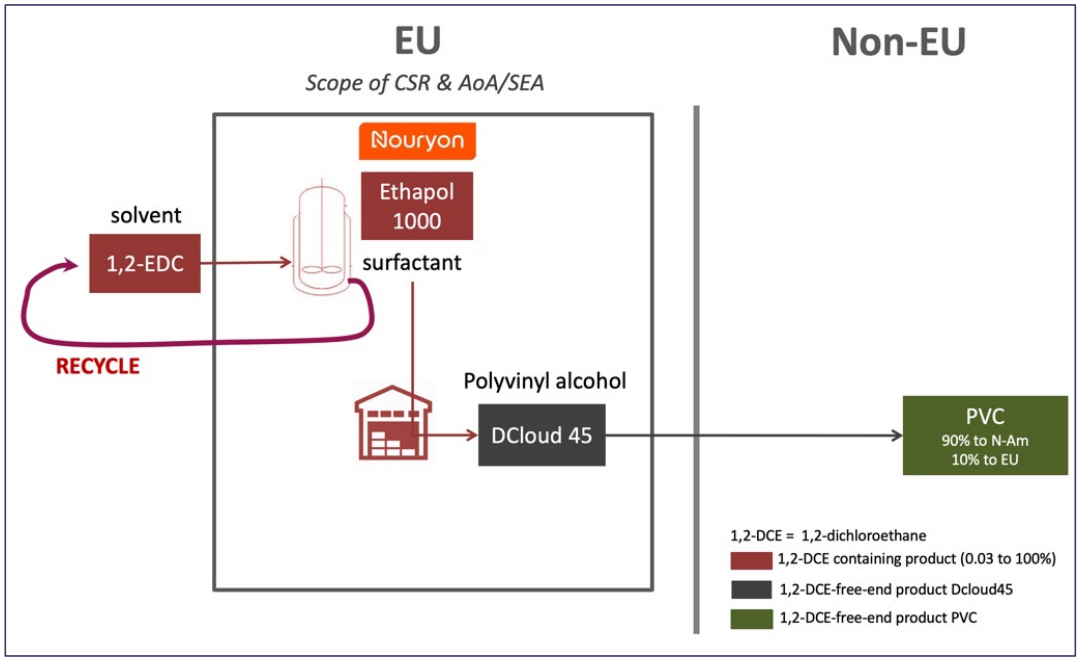




PERC although not a preferred alternative
(from a risk perspective), the quickest and cheapest alternative
in case of refused or even short term (4-7yrs) authorisation!
Thus, **no or short-term authorisation would have resulted in substitution to PERC = regrettable**

Switchable solvent = innovative, sustainable alternative
Risk reduction and reduction of energy consumption
Development time estimated at 12 yrs → but also follow-up of new developments as contingency plan

1,2-dichloroethane @ Nouryon



1,2-EDC as solvent in production of surfactant

1,2-EDC is recycled in the process

Surfactant (Ethapol 1000) is used to make DCloud45

DCloud45 is a PVA used in PVC

PVC is used in piping, cable insulation, blood bags, …

DCLoud45 is **the only PVA**
with zero methanol & zero ethanol
Key to US PVC manufacturers for reasons of
(1) explosion safety, and
(2) to comply with US Clean Air Act on
methanol emission reduction obligations

Drop-in Alternative

Alternative solvents

Alternative Technology

Alternative chemistry

Alternative End-product

Alternative surfactant

Relocation (out of EEA)

Production in Mexico

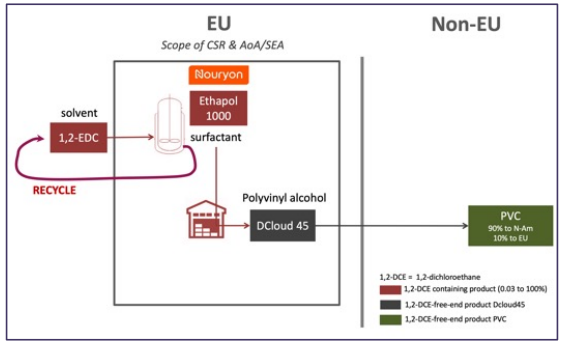
Closure

Cyclohexane
possible in 6yrs
but not most sustainable!

Water-based polymerisation
Innovative, sustainable
but takes more time, 9yrs
Preferred alternative

Alternative to Ethapol1000, or
Alternative to DCloud45

= cheapest non suitable alternative
= *non-use scenario (= no authorisation)*



Koen Vanduffel, Nouryon

"If we would have received limited time, then we would have been forced to bet on the quickest horse."

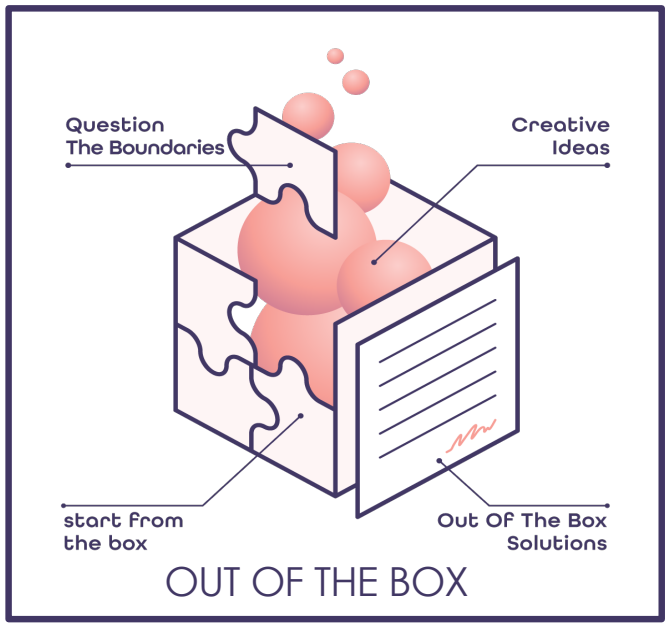
= cyclohexane, i.e. the least sustainable alternative.
Because 9 years was granted, OK to innovate for a sustainable alternative.

Authorisation was granted until 22 Nov 2026.
Development was quicker than expected, Implementation now planned in 2022!

Alternative Mindset

Which skills do you need to reach safe substitution?

- R&D
- Engineering – Process Technology
- Risk Assessment
- Market & Business
- Economic Assessment
- Strategy – scenario thinking
- Out-of-the-box thinking



Learning

- Alternative Assessment is multidimentional (tox, climate, circularity, use of resources)
- "Safe" or "Sustainable" Substitution requires **INNOVATION** (functional substitution)
- Innovation requires **TIME**
- Substitution under time pressure leads to suboptimal substitution or, worst case, to regrettable substitution
- Innovation requires insight knowledge from the **USER**
- Innovation shall consider the entire life cycle, to avoid a shift of the risk
- Priority setting for substitution is key. Optimal use of resources by tackling first those uses where we can gain the maximum positive impact for society.

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A4 Community of Practice

- Are there other resources, strategies, tools that you've found useful to find alternatives?
- Do you have insights on or questions about the processes, resources described by Anna, Amelia and Elke?

Please raise your hand or post your thoughts in the chat

Announcements

For program information visit the A4 website: www.saferalternatives.org

Announcements

Call for Abstracts
Submission Deadline: July 16th

- **New Methods and Approaches for Evaluating and Identifying Safer AND Sustainable Alternatives**
- **Implementation of Alternatives Assessment in Public and Private Decision-Making**

The A4 Program Committee will issue awards to: (1) the best student presentation and (2) the best early-career investigator presentation.

For program information visit the A4 website: www.saferalternatives.org

ASSOCIATION FOR THE ADVANCEMENT OF ALTERNATIVES ASSESSMENT

A new professional association solely dedicated to advancing the science, practice, and policy of alternatives assessment and informed substitution

JOIN THE A4!

Working collaboratively to accelerate the use of safer chemicals, materials, processes, and products

www.saferalternatives.org

THANK YOU