Alternatives Assessment in EU
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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
since 2009

Passion

to drive Improvement

Together with our clients
The Team

Celina  Tine  Laurence  Richard  Katrien

Hiram  Elke  Valérie  Mike  Valentina

Michel  Shari  Laetitia  Eva  Willy
DRIVING THE TRANSITION

Starting from safe use of chemicals, Apeiron guides its clients to sustainable, future proof business operations.
Stepping up from “LINEAR-IN-A-CIRCLE” to “CIRCULAR”

Optimization of the **parts**
One party can be dominant

MY GAIN = YOUR LOSS

Linear-in-a-circle
= Bilateral system

OR

Optimization of the **system**
as result of trust & stability

WIN-WIN

Circular
= Ecosystem
Chemicals are used everywhere and that is OK, they bring health & prosperity for society

- Surfactant in *in vitro* diagnostics used to diagnose diseases, e.g. Covid-19
- Solvent used in the production of promising innovative cancer treatment
- UV filters in sunscreen to protect us from skin cancer
- Adsorbing agents used in sanitary towels and tampons
- Polymers used in tents to make them light and weather resistant in the mountains
- Surface treatment that ensures that the ballustrade of your 6th floor apartment is robust

but ... we need to maximally avoid Substances of (Very High) Concern
Apeiron assesses its client’s substance portfolio for improvement opportunities. We identify where they can achieve the **biggest impact with the available resources**.

Apeiron developed a **standard methodology** with **Priority setting** for **Proactive Alternatives Assessment**.

This includes assessment of

- Toxicity & Risk
- Climate
- Circularity
- Resource depletion

For the entire life cycle of the substances

→ ensuring the alternative does not create a new risk up-or downstream = regrettable substitution
→ e.g. Alternatives for Cr(VI) based on Cr(III)sulfate, which is produced starting from Cr(VI).
## Alternatives Assessment (AA)

<table>
<thead>
<tr>
<th>Reactive AA</th>
<th>Proactive AA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Result of <a href="#">legal obligation</a>, Fits in a regulatory process e.g. REACH</td>
<td>Fits in <a href="#">voluntary</a> effort</td>
</tr>
<tr>
<td>Pushes all companies to improvement</td>
<td>Works only with fronrunners, while others lag behind</td>
</tr>
<tr>
<td>Demonstrates there is no suitable alternative = <a href="#">negative</a> assessment</td>
<td>Looks open-mindedly for future opportunities = <a href="#">positive</a> assessment</td>
</tr>
<tr>
<td>義務 to make commitment via substitution plan</td>
<td></td>
</tr>
<tr>
<td>Has to stand <a href="#">external</a> scrutiny</td>
<td><a href="#">Internal</a> process</td>
</tr>
<tr>
<td>Time for substitution = minimum needed</td>
<td>Time as needed to develop the most sustainable alternative</td>
</tr>
<tr>
<td>Time is intrinsic element of AA &amp; of decision by authorities</td>
<td></td>
</tr>
<tr>
<td>Time pressure = Risk for <a href="#">regrettable</a> substitution</td>
<td>Most <a href="#">optimal</a> substitution for <a href="#">industry</a> &amp; society</td>
</tr>
<tr>
<td>Unless sufficient time is granted! (see examples later)</td>
<td>(see examples later)</td>
</tr>
</tbody>
</table>
Proactive Alternatives Assessment is more effective to achieve sustainable substitution but only the frontrunners act. Thus, to make a difference...

the world needs regulatory & voluntary actions
Alternatives Assessment under REACH & Beyond

"Look for the alternative"
Safe Use of Chemicals

Registration

= Inventory of Substances
= Gathering all EU sheep & Defining the Borders of Safe Use

Evaluation

= Evaluation of Substances
= Identifying the black sheep

Authorisation & Restriction

= Ban of the black sheep (A)
= Isolating the black sheep (R)
What is an SVHC?

- Carcinogen to humans
- Mutagen to humans (DNA damage)
- Reprotoxic to humans (fertility and/or development of foetus)
- PBT / vPvB
- Equivalent concern
- Endocrine disruptors
- Respiratory sensitizers
- PMT/vPvM
Restriction
Annex XVII

Subst with risk in EEA

Allowance to use, under restricted conditions ➔ Forbidden zones

Authorisation
Annex XIV

SVHC
CMR cat 1A/B
PBT/vPvB
Equiv. concern:
- endocrine disrupt.
- Resp. sensitizers
- PMT/vPvM
- ...

Prohibited to use, unless authorisation granted ➔ Islands of allowed use ➔ Time Limited

'SVHC = Substances of Very High Concern
Application for Authorisation

1. Risks properly controlled
2. SVHCs progressively replaced

= AIM AUTHORISATION (art 55)
Exposure & emissions are minimized
Opportunities to further reduce emissions

Description R&D history
Opportunities to find even better solutions

Balance of impacts
“use -applied-for” vs “non-use”
EXPOSURE → RISK → IMPACT

- Dose response curve
- # people
- €: WTP / other
Key Functional Requirements
In-company expertise

Key Functional Requirements

Suppliers

At level of Substance

Customers

At level of End-Product

Competitors

Google

Dbases (WIPO Green, Market Place, Chemycal, ...)

Green Chem. Conferences
Reduction of Risk

Technical feasibility

Availability

Economic feasibility

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
the AoA defines the future business strategy
Authorisation is **not avoiding** substitution

Authorisation is **a plan towards** substitution, while emissions & exposure (to workers & man-via-env) are continuously improved/miminished
What can we learn from Example Cases?
HBCDD

- Flame retardant for EPS and XPS
- PBT properties
- Regulated by POPs convention (2013)
- Included in Annex XIV of REACH (2009) as one of the first substances
- Sunset date for the substance 21/8/2015
Drop-in Alternative

Alternative Flame Ret.

Alternative Technology

Alternative EPS process

Alternative End-product

Relocation (out of EEA)

Various options

Closure

Polymeric Brominated FR

Large number of EPS sites in operation

Longer to replace

Life cycle of installation

Much more expensive

LCA analysis

Less reduction of risk e.g. glassfibre

Not viable (climate & economic)

to transport EPS

⇒ Low density of EPS
Joint effort between flame retardant suppliers & EPS producers
Pro-Active research before regulatory scrutiny: 9 years search (2003-2012)
Authorisation requested for only 2yrs until enough market volume of alternative available
Authorisation granted for the 2yrs. Substitution in meantime completely implemented.
Learning

Joined effort between users and producers

- **Proactive AA** based on inherent property of substance
- Acting **ahead of regulatory requirement** is effective
Trichloroethylene
Closed box in a closed box

IN

PROC-1

DE- WAXING UNIT

SEAL TCE H₂O RINSING 1st WASHING

OUT

200 k€

0,5 ppm

DECREASE

0,06 ppm

3:100.000

< 10% of background conc.

< 4:10.000.000
PERC although not a preferred alternative (risk, technically, economically and availability), 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
Ongoing R&D

• **Innovation** to sustainable alternatives requires **time**
• Switchable solvents, but the applicant also continued R&D to other technologies in case switchable solvents would not work out
• Open minded to the best possible solution for applicant & society

• Footnote: AA by downstream versus AA by Manufacturer of the substance
  - Manufacturer typically develops drop-in alternatives only (other solvents)
  - **Conflict of interest**: manufacturer or supplier high up in the supply chain is not interested in alternatives he cannot produce, e.g. new technologies at downstream user
  - Significant uncertainties in the dossier due to aggregation of information. This leads to **shorter authorised periods**.
  - Result: No time for development of innovative alternatives. In practice...a **significant number of TCE users have in the meantime switched to PERC**
Regulation is a good trigger for substitution. But...Substitution under time pressure leads to suboptimal substitution or - worst case – to regrettable substitution.

Substitution from Trichloroethylen to Perchloroethylene is a regrettable substitution. But unfortunately this is what happened in reality, because the downstream users were not sufficiently involved in the AA process.
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
No authorisation (NPV) ca. **2,980,000€**

€ **HH** during review period = ca. **262€**

0,0000168 total fatal cancers cases per year
Drop-in Alternative

Alternative solvents

Alternative Technology

Alternative chemistry

Alternative End-product

Alternative surfactant

Relocation (out of EEA)

to Mexico site

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)
“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!
When **sufficient time** is granted, then targeted R&D can lead to an **INNOVATIVE & SUSTAINABLE** alternative.

If the authorised time would have been limited to 6yrs, then the applicant would have focussed its R&D on the quickest potential alternative, which is the least sustainable one.

Granting the applicant more time, allowed them to develop alternatives in parallel.
Hexavalent Chromium

- Very large number of DUs
- Various uses for surface treatment
- Various end products
  - Automotive
  - Architecture
  - Can making
  - Rifle barrels
- Concern is workers exposure
Drop-in Alternative

Cr(III) based

Alternative Technology

e.g. PVD

Alternative End-product

Plastic packaging

Relocation (out of EEA)

Reality.

Closure

Reality.

Not observed

Has been reported

in some cases no reduction of risk in the supply chain

for some uses, But in general More expensive Less performant

Not observed

Is currently happening (SMEs)
- R&D on Cr(VI) substitution ongoing for decades
- Several uses ➔ different alternatives
- AA made by suppliers of Cr(VI) ➔ only drop-in alternatives based on chromium
- Cr(III) still requires Cr(VI) in the supply chain (either in the production of Cr(III) compounds like Cr(III)sulfate, starting from sodium dichromate, or Cr(VI) release during mining)
- Innovative and sustainable alternative = chromium free
- Companies spent millions and substituted – with good intentions! - to Cr(III) as result of time pressure
- Substitution partially achieved, partially regrettable
- And what about the other substances in the process? Ni, borates, PFAS, ....
- Was it worth it?
Was it worth it?
Real life example: sum of 3 Cr(VI) authorisations

Investment (NPV) ca. 161.500.000 €

€ HH during review period = ca. 225.000 €

0.0056 total fatal cancers cases per year
Is this 190,000,000 € from the applicants, money well spent for SOCIETY?
What if...ALTERNATIVE-ly?

... we make the desert green again?

Project by Lignaverda https://lignaverda.org/en/
### 190.000.000€ Investment

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hectare trees</td>
<td>317.300</td>
<td></td>
</tr>
<tr>
<td>Ton CO₂/yr</td>
<td>1.073.500</td>
<td>= 107.350 Belgians (CO₂ emission)</td>
</tr>
<tr>
<td>Cash crops/yr</td>
<td>5.288.333€</td>
<td>Gum, balanites oil</td>
</tr>
<tr>
<td>Grass/yr</td>
<td>3.807.600€</td>
<td></td>
</tr>
<tr>
<td>Direct employment</td>
<td>380.000</td>
<td>= 1.331 villages</td>
</tr>
<tr>
<td>Indirect employment</td>
<td>380.000</td>
<td></td>
</tr>
</tbody>
</table>
190,000,000€ Investment

Investment (NPV) ca. 161,500,000€

471,000,000€ *

*NPV (4%) 20yrs incl. cash crop, grass, CO₂ capture
HH cost of Cr(VI) use deducted
INDIRECT IMPACTS

PLANET

PEOPLE

PROSPERITY

PARTNERSHIPS

PEACE (STOP MIGRATION)
Alternatives Assessment of Investment

**Alternative A: Substitute SVHC**

- Investment (NPV) ca. 161,500,000€
- € HH during review period = ca. 225,000€
- 0.0056 total fatal cancers cases per year

**Alternative B: Make dessert green**

- Investment (NPV) ca. 161,500,000€
- 471,000,000€ * incl. cash crop, grain, CO₂ capture HH cost of Cr(VI) use deducted
Regrettable substitutions in view of overall risk (Cr(III) still leads to Cr(VI) exposure higher up in supply chain), societal considerations & wasting resources

**Learning**

**Prioritization**  
For substitution, prioritization is key.  
First those with **maximum positive impact for society**

Substances not leading to exposure of general population should **not** be the first priority.  
These can be tackled when the bigger problems are solved.  
In the mean time the risk can be mitigated (e.g. Binding OEL)
What can we CONCLUDE for companies outside EU?
- Regulation drives Innovation
- Proactive AA are more effective
- AA is multidimensional (tox, climate, circularity)
- Innovation requires TIME
- Innovation requires insight knowledge from the downstream user
- Innovation shall consider the entire life cycle, to avoid a shift of the risk
- A priority setting for substitution is key.

Optimal use of resources to maximize positive impact for society
QUESTIONS AND ANSWERS
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