Global Chemicals Outlook II – From Legacies to Innovative Solutions

Ready, set, substitute it now!

Brussels, Belgium, 14 November 2019
The Global Chemicals Outlook II (GCO-II)

- First GCO published in 2013, highlighting chemical intensification
- GCO-II launched in 2019 at various meetings and conferences
- Informs UNEA and intersessional process considering the Strategic Approach and the sound management of chemicals and waste beyond 2020

Available products:
- Full GCO-II
- Synthesis report
- Summary for policymakers

https://www.unenvironment.org

Johannesburg Plan of Implementation, para 23: “… aiming to achieve, by 2020, that chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment …”
Structure of the GCO-II

Part I: The evolving chemicals economy: status and trends relevant for sustainability

Part II: Where do we stand in achieving the 2020 goal – assessing overall progress and gaps

Part III: Advancing and Sharing Chemicals Management Tools and Approaches: Taking Stock, Looking into the Future

Part IV: Enabling policies and action to support innovative solutions

Part V: Scaling up collaborative action under the 2030 Agenda for Sustainable Development
Chemicals production and consumption

- More than USD 5 trillion industry in 2017 (including pharmaceuticals)
- Sales projected to double by 2030
- Production and consumption shifting to emerging economies

Projected growth in world chemical sales (excl. pharmaceuticals) (CEFIC)
Megatrends, the chemical industry and chemical-intensive sectors

- Rising income and growing middle classes drive demand
- Production of some legacy chemicals has significantly declined
- Megatrends create risks and opportunities across sectors

Growth of basic chemical production capacity vs. population growth (based on Cayuela and UN DESA)
Concentrations of chemicals

- Chemical pollutants ubiquitous in environment and humans
- Legacy chemicals present in remotest regions of the world
- Concentrations vary by substance, region and environmental media
- Limited data indicate positive trends in reducing concentrations of regulated chemicals; concentrations of some others increasing
- Chemicals of concern concentrate in buildings and jeopardize air quality

*Trends in concentrations of PCBs in Košetice, Czech Republic, 1996-2013 (adapted from Šebková et al. 2014, p. 61)*
WHO estimated the burden of disease from selected chemicals at 1.6 million lives in 2016.

Foetuses, infants, children, pregnant women, elderly and poor among the most vulnerable.

Chemical pollution threatens ecosystem services.

Costs of inaction and benefits of action estimated to be significant.

Effects of chemicals

Deaths (total: 1.6 million) attributed to selected chemicals in 2016 (WHO 2018)
Other issues with emerging evidence of risk

- UNEA requested that the GCO-II address other issues where emerging evidence indicates a risk to human health and the environment.

Criteria-based approach resulted in the identification of:

<table>
<thead>
<tr>
<th>Arsenic</th>
<th>Neonicotinoids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bisphenol A (BPA)</td>
<td>Organotins</td>
</tr>
<tr>
<td>Glyphosate</td>
<td>Polycyclic aromatic hydrocarbons (PAHs)</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Phthalates</td>
</tr>
<tr>
<td>Lead</td>
<td>Triclosan</td>
</tr>
<tr>
<td>Microbeads</td>
<td></td>
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</tbody>
</table>
Risk management decision-making

- Complementing government initiatives, frontrunner private governance can drive risk management beyond compliance.
- Socio-economic analysis addressing costs and benefits of action and non-action is useful to inform decision-making; caution in the interpretation of results is required.
Assessment of chemical and non-chemical alternatives

- Regulatory action, public pressure and voluntary initiatives drive safer alternatives in products and processes
- Conventional approaches focus on drop-in replacements
- Informed substitution to provide a safer functional match, including non-chemical alternatives
# Functional substitution approach

<table>
<thead>
<tr>
<th>Functional substitution level</th>
<th>Chemical in product</th>
<th>Chemical in process</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bisphenol A in thermal paper</td>
<td>Methylene chloride in degreasing metal parts</td>
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**Chemical function** (Chemical change)

- Is there a functionally equivalent chemical substitute (i.e. chemical developer)?
- **Result:** Drop-in chemical replacement

- Is there a functionally equivalent chemical substitute (i.e. chlorinated solvent degreaser)?
- **Result:** Drop-in chemical replacement

**End Use function** (Material, product, process change)

- Is there another means to achieve the function of the chemical in the product (i.e. creation of printed image)?
- **Result:** Redesign of thermal paper, material changes

- Is there another means to achieve the function of the process (i.e. degreasing)?
- **Result:** Redesign of the process (e.g. ultrasonic, aqueous)

**Function as service** (System change)

- Are cash register receipts necessary? Are there alternatives that could achieve the same purpose (i.e. providing a record of sale to a consumer)?
- **Result:** Alternative printing systems (e.g. electronic receipts)

- Is degreasing metal parts necessary? Are there alternatives that could achieve the same purpose (i.e. providing metal parts free of contaminants for other end uses)?
- **Result:** Alternative metal cutting methods

_A functional substitution approach for chemicals in products and processes (Tickner et al. 2015)_
Assessment of chemical and non-chemical alternatives - Continued

- Alternatives assessments to avoid regrettable substitutions
- Challenges include lack of supportive policies, insufficiently mature methodologies, data gaps and limited experience

<table>
<thead>
<tr>
<th>Chemical of concern (function)</th>
<th>Hazard of chemical of concern</th>
<th>Substitute</th>
<th>Hazard of substitute</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPA (used in production of plastics)</td>
<td>Endocrine disruption</td>
<td>BPS, Bisphenol F</td>
<td>Endocrine activity</td>
</tr>
<tr>
<td>DEHP (plasticizer)</td>
<td>Endocrine disruption</td>
<td>Diisononyl phthalate</td>
<td>Carcinogenicity, possible endocrine disruption</td>
</tr>
<tr>
<td>Methylene chloride (solvent carrier in adhesives)</td>
<td>Acute toxicity, carcinogenicity</td>
<td>1-Bromopropane (nPB)</td>
<td>Carcinogenicity, neurotoxicity</td>
</tr>
<tr>
<td>Methylene chloride (brake cleaners)</td>
<td>Acute toxicity, carcinogenicity</td>
<td>n-Hexane</td>
<td>Neurotoxicity</td>
</tr>
<tr>
<td>Polybrominated diphenyl ethers (flame retardant)</td>
<td>Persistence, neurotoxicity, reproductive toxicity, carcinogenicity (penta and deca)</td>
<td>Tris (2,3-dibromopropyl) phosphate</td>
<td>Carcinogenicity, aquatic toxicity</td>
</tr>
<tr>
<td>TCE (metal degreasing)</td>
<td>Carcinogenicity</td>
<td>nPB</td>
<td>Neurotoxicity, carcinogenicity</td>
</tr>
</tbody>
</table>

Examples in the literature referring to potential regrettable substitution (Siddiqi, Laessig and Reed 2003; US CDC 2008; Birnbaum and Bergman 2010; US NTP 2011; Ichihara et al. 2012; ECHA 2013; Tomar, Budroe and Cendak 2013; Eladak et al. 2015; Rochester and Bolden 2015; Canadian Centre for Occupational Health and Safety 2017; Anastas, Constable and Jiménez-González 2018; Jamarani et al. 2018; Sackmann et al. 2018)
The future of chemistry

- Chemistry’s potential to advance sustainable development
- Enhancing understanding of green and sustainable chemistry
- Sustainable chemistry is an evolving concept that may serve as a reference for chemistry innovation
- Opportunities exist to mainstream green and sustainable chemistry education into curricula and teaching, in particular in developing countries

Global green chemicals market by region, 2011-2020 (Pike Research 2011, p. 432)

Number of papers published concerning green chemistry education or sustainable chemistry education, 1998-July 2017 (adapted from Clarivate 2018)
Green and sustainable chemistry education

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Fiscal Incentives

- Market-based instruments create incentives for cost-effective substitution and can spur innovation.

*Marginal cost of reducing the use of trichloroethylene (TCE) or replacing it altogether in metal degreasing* (adapted from Slunge and Sterner 2001, p. 292)
Sustainability metrics and reporting

- Private sector metrics and reporting proliferating and hold significant potential to measure progress
- Efforts needed to align approaches, ensure reporting is meaningful, increase transparency, and address the lack of a sustainable chemistry assessment framework
Overall message of the GCO-II

• While many chemicals are important for sustainable development, trends are a cause for major concerns.

• The global goal to minimize adverse impacts of chemicals and waste will not be achieved by 2020

• Solutions exist, but more ambitious worldwide action by all stakeholders is urgently required

• Business-as-usual is not an option
Chemicals and waste management beyond 2020 –

*What are the ingredients for success?*
Towards a comprehensive global framework beyond 2020

- A global common vision, strategic goals, targets and indicators
- Needs to be aspirational, comprehensive and create incentives for all actors to engage and commit
Thank you for your attention

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