DRAFT FOR DISCUSSION ONLY

From Helen Holder, Green Ribbon Science Panel
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Evaluation of life cycle impacts of an alternative to a chemical of concern

As per AB 1879 / Health and Safety Code (HSC) section 25253 (a) (2)\

Goal: identify potential unintended consequences in order to disqualify an alternative or to trigger risk reduction actions

(A) Product function or performance.
(B) Useful life.
(C) Materials and resource consumption.
(D) Water conservation.
(E) Water quality impacts.
(F) Air emissions.
(G) Production, in-use, and transportation energy inputs.
(H) Energy efficiency.
(I) Greenhouse gas emissions.
(J) Waste and end-of-life disposal.
(K) Public health impacts, including potential impacts to sensitive subpopulations, including infants and children.
(L) Environmental impacts.
(M) Economic impacts.

A. Product function or performance.

Are there governing safety standards or performance standards that must be used to determine the minimum functionality if this material (e.g. UL 62 and UL 817 for power cords)?

☐ Yes. List. _____

☐ No. Describe the test or criteria used to determine the minimum functionality for alternatives to the chemical of concern. _____

Definition
(59) "Technically and economically feasible alternative" means an alternative product or chemical for which:
(A) The technical knowledge, equipment, materials, and other resources available in the marketplace are expected to be sufficient to develop and implement the alternative, and to meet consumer demand after an appropriate phase-in period; and
(B) The manufacturer's operating margin is not significantly reduced.

(31) "Functionally acceptable" means that an alternative product meets both of the 33 following requirements:
34 (A) The product complies with all applicable legal requirements; and
35 (B) The product performs the functions of the original product sufficiently well that 36 consumers can be reasonably anticipated to accept the product in the marketplace.

H = alternative performs worse than CoC
M = alternative performs same as CoC
L = alternative performs better than CoC

B. Useful life.

Is this alternative expected to have a longer, shorter, or equivalent service life than the original chemical or technology?

☐ Equivalent or longer

☐ Shorter. If shorter, why? (e.g. new failure mode, etc.) _____

Definition

(61) "Useful life" means the period of time during which a product can be used for its intended use, expressed in terms of a single use, number of applications, or days, months, or years of use.

C. Materials and resource consumption.

Definition

(42)(A) "Materials and resource consumption" means the consumption of renewable and nonrenewable resources that are used for a consumer product throughout its life cycle.

(B) Except as specified in subparagraph (C)2., a renewable resource is a resource that is capable of being replaced by natural processes at a rate equal to or faster than its consumption rate. Renewable resources include solar and wind energy, timber, agriculture, and water.

(C) Both of the following are nonrenewable resources:

1. An inherently finite resource that is formed over long periods of geologic time, including petroleum, coal, metals (mined and recycled), minerals, and other finite resources; and

2. A resource that meets the definition of a renewable resource, specified in subparagraph (B), but the resource is consumed at a rate that exceeds the rate at which it is replaced such that its continued use would drive the resource to exhaustion.

Resources

1. **Water conservation**

   Is more water used in manufacturing this product compared to the chemical of concern?

   ☐ Not applicable

   ☐ No

   ☐ Yes

   *If yes, approximately how much more per unit of product (% increase)?*_____

2. **Resource use**

   a. Is more metal used in manufacturing this product compared to the chemical of concern?

      ☐ Not applicable

      ☐ No

      ☐ Yes

*If yes, approximately how much more per unit of product (% increase)?*_____

b. Is more plastic used in manufacturing this product compared to the chemical of concern?
☐ Not applicable
☐ No
☐ Yes
*If yes, approximately how much more per unit of product (% increase)?*_____

c. Is more glass used in manufacturing this product compared to the chemical of concern?
☐ Not applicable
☐ No
☐ Yes
*If yes, approximately how much more per unit of product (% increase)?*_____

d. Is more wood used in manufacturing this product compared to the chemical of concern?
☐ Not applicable
☐ No
☐ Yes
*If yes, approximately how much more per unit of product (% increase)?*_____

e. Is more paper used in manufacturing this product compared to the chemical of concern?
☐ Not applicable
☐ No
☐ Yes
*If yes, approximately how much more per unit of product (% increase)?*_____

D. Water conservation.

3. **Water conservation**
Is more water used in manufacturing this product compared to the chemical of concern?
☐ Not applicable
☐ No
☐ Yes
*If yes, approximately how much more per unit of product (% increase)?*_____

E. Water quality impacts.

(10) "Adverse water quality impacts" means any of the following adverse effects on the beneficial uses, as specified in Water Code section 13050(f) or adopted in a Water Quality Control Plan under article 3 of chapter 3 and/or article 3 of chapter 4 of division 7 of the Water Code, of the waters of the State, which include groundwater, fresh water, brackish water, marsh lands, wetlands, or coastal bodies or systems:
(A) Increase in biological oxygen demand;
(B) Increase in chemical oxygen demand;

(C) Increase in temperature;
(D) Increase in total dissolved solids; or
(E) Introduction of, or increase in, any of the following:
1. Priority toxic pollutants identified for California under section 303(c) of the federal Clean Water Act;
2. Pollutants listed by California or the Environmental Protection Agency for one or more water bodies in California under section 303(d) of the federal Clean Water Act;
3. Chemicals for which primary Maximum Contaminant Levels (MCLs) have been established under Health and Safety Code section 116365(a), or by the Environmental Protection Agency under the federal Safe Drinking Water Act;
4. Chemicals for which Notification Levels (NLs) have been specified under Health and Safety Code section 116455; or
5. Chemicals for which public health goals for drinking water have been published under the California Safe Drinking Water Act (commencing with Health and Safety Code section 116270).

a. Water

i. Under normal use conditions, would the product be expected to enter a Publicly Owned Treatment Works (POTW) [40 CFR 403.3(o)] through municipal sewage (e.g. personal care products down the drain)?
☐ No
☐ Yes
If yes, complete the Water Worksheet.

ii. Under normal use conditions, would the product be expected to directly enter the municipal storm sewer systems (e.g. car wash detergents)?
☐ No
☐ Yes
If yes, complete the Water Worksheet.

iii. Does the product, its constituents, or its likely breakdown products include any Priority or Non Priority Pollutants from US EPA National Recommended Water Quality Criteria (published under Section 304(a) of the Clean Water Act)?
☐ No
☐ Yes
If yes, complete the Water Worksheet.

iv. If the alternative is a chemical, does your company or facility have an NPDES permit for discharge of this substance?
☐ Not applicable
☐ No
☐ Yes
If yes, attach permit and water quality plan.

v. If the alternative is a chemical, is the half life in water of the substance or any of its breakdown products >40 days?
☐ Not applicable
☐ No

☐ Yes
If yes, complete the Water Worksheet.

vi. If the alternative is a chemical, does it or any of its likely breakdown products have an LC50 or EC50 > 1mg/L?
☐ Not applicable
☐ No
☐ Yes
If yes, complete the Water Worksheet.

vii. If the alternative is a chemical, does it or any of its likely breakdown products have an NOEC or LOEC > 0.1mg/L?
☐ Not applicable
☐ No
☐ Yes
If yes, complete the Water Worksheet.

If the alternative is a chemical, does it or any of its likely breakdown products have a bioconcentration factor (BCF) or bioaccumulation factor (BAF) > 1000?
☐ Not applicable
☐ No
☐ Yes
If yes, complete the Water Worksheet.

F. Air emissions.

(3) "Adverse air quality impacts" means air emissions of any of the air contaminants listed below that have the ability to result in adverse public health, ecological, soil, or water impacts:
(A) California Toxic Air Contaminants as specified in Title 17, California Code of Regulations, sections 93000 through 93001;
(B) Greenhouse gases, which means any of the following gases:
1. Carbon dioxide;
2. Hydrofluorocarbons;
3. Methane;
4. Nitrogen trifluoride;
5. Nitrous oxide;
6. Perfluorocarbons;
7. Sulfur hexafluoride; or
8. Gases that exhibit the global warming potential hazard trait, as specified in section 69405.4;
(C) Nitrogen oxides;
(D) Particulate matter that exhibits the particle size or fiber dimension hazard trait, as specified in section 69405.7;
(E) Chemical substances that exhibit the stratospheric ozone depletion potential hazard trait, as specified in section 69405.8;
(F) Sulfur oxides; or
(G) Tropospheric ozone-forming compounds, including compounds that exhibit the ambient ozone formation hazard trait, as specified in section 69405.1.

a. Air

i. Under normal use conditions, would the product be expected to be burned or subjected to combustion (e.g. lighter fluid)?
☐ No
☐ Yes
If yes, complete the Air Worksheet.

ii. Does the product contain or release Volatile Organic Compounds (VOCs, 40 CFR, Chapter 1, Subchapter C, Part 51, Subpart F, 51100)?
☐ No
☐ Yes
If yes, complete the Air Worksheet.

iii. Are Volatile Organic Compounds (VOCs) used in the manufacture of this product?
☐ No
☐ Yes
If yes, complete the Air Worksheet.

iv. Is the product intended to be used in particulate form (e.g. talc)?
☐ No
☐ Yes
If yes, complete the Air Worksheet.

Is the product in particulate form at any point in the manufacturing process?
☐ No
☐ Yes
If yes, complete the Air Worksheet.

G. Production, in-use, and transportation energy inputs.
– embedded+use (cradle to gate)
-not in regs

4. Energy

What is the approximate carbon footprint for each of the following parts of the life cycle for the alternative compared to the chemical of concern, as calculated on [Earthster/common LCIA]:
Change to more/less/same checkboxes

	Alternative	Chemical of Concern
Resource extraction		
Manufacturing		
Transport		
Use		
End-of-life disposal		

H. Energy efficiency. – only if EUP? - use phase, look up EPEAT criteria
What about cars? Diesel generators?
Not in regs

I. Greenhouse gas emissions. – calc carbon footprint from (G.)
Not in regs

J. Waste and end-of-life disposal.

(9) "Adverse waste and end-of-life impacts" means the materials and byproducts generated during the life cycle of the Priority Product and/or each alternative being considered, including degradates and reaction products, and the associated adverse public health or environmental impacts due to any of, or a combination of, the following:
(A) The volume or mass generated;
(B) Any special handling requirements needed to mitigate adverse impacts;
(C) Impacts on solid waste disposal and treatment, including operation of solid waste handling or treatment facilities;
(D) Discharge or disposal to storm drains or sewers, contributing to adverse impacts on operation of wastewater or storm water treatment facilities; or
(E) Release into the environment, as a result of solid waste handling, treatment, or disposal activities or the discharge or disposal to storm drains or sewers, of either or both of the following:
1. The Chemical(s) of Concern contained in the Priority Product or alternatives; and/or
2. Any other chemical contained in the alternatives that differs from the chemicals contained in the Priority Product.

a. Solid waste and end of life disposal

viii. Is this product, its constituents, or any of its likely breakdown products listed as an EPA RCRA hazardous waste (40 CFR 261)?
☐ No
☐ Yes
If yes, complete the Waste Worksheet.

ix. Is this product, its constituents, or any of its likely breakdown products an EPA RCRA characteristic hazardous waste (40 CFR 261.21-261.24)?
☐ No
☐ Yes
If yes, complete the Waste Worksheet.

x. Can this product be reused or recycled at any point in product life cycle, including manufacturing?
☐ No
☐ Yes
If yes, describe. _____

Has your company or facility completed a waste characterization report (WCR) for waste from this product at any point in the product life cycle, including manufacturing and end-of-life disposal?

☐ No
☐ Yes
If yes, attach waste characterization report (WCR).

K. Public health impacts, including potential impacts to sensitive subpopulations, including infants and children.
L. Environmental impacts.

(5) "Adverse environmental impacts" means any of the following:
(A) Adverse air quality impacts;
(B) Adverse ecological impacts;
(C) Adverse soil quality impacts;
(D) Adverse water quality impacts; or
(E) Exceedance of an enforceable California or federal regulatory standard relating to the protection of the environment.

(3) "Adverse air quality impacts" means air emissions of any of the air contaminants listed below that have the ability to result in adverse public health, ecological, soil, or water impacts:
(A) California Toxic Air Contaminants as specified in Title 17, California Code of Regulations, sections 93000 through 93001;
(B) Greenhouse gases, which means any of the following gases:
1. Carbon dioxide;
2. Hydrofluorocarbons;
3. Methane;
4. Nitrogen trifluoride;
5. Nitrous oxide;
6. Perfluorocarbons;
7. Sulfur hexafluoride; or
8. Gases that exhibit the global warming potential hazard trait, as specified in section 69405.4;
(C) Nitrogen oxides;
(D) Particulate matter that exhibits the particle size or fiber dimension hazard trait, as specified in section 69405.7;
(E) Chemical substances that exhibit the stratospheric ozone depletion potential hazard trait, as specified in section 69405.8;
(F) Sulfur oxides; or
(G) Tropospheric ozone-forming compounds, including compounds that exhibit the ambient ozone formation hazard trait, as specified in section 69405.1.

(4) "Adverse ecological impacts" means any of the following direct or indirect effects on living organisms and their environments:
(A) Adverse impacts to aquatic, avian, or terrestrial animal or plant organisms or microbes, including:
1. Acute or chronic toxicity;
2. Changes in population size, reductions in biodiversity, or changes in ecological communities; and

3. The ability of an endangered or threatened species to survive or reproduce;
(B) Adverse impacts on aquatic and terrestrial ecosystems including:
1. Deterioration or loss of environmentally sensitive habitats;
2. Impacts that contribute to or cause vegetation contamination or damage; and
3. Adverse impacts on environments that have been designated as impaired by a California State or federal regulatory agency;
(C) Biological or chemical contamination of soils; or
(D) Any other adverse effect, as defined in section 69401.2(a), for environmental hazard traits and endpoints specified in article 4 of chapter 54.

(8) "Adverse soil quality impacts" means any of the following effects on soil function or properties:
(A) Compaction or other structural changes;
(B) Erosion;
(C) Loss of organic matter; or
(D) Soil sealing, meaning the covering of the surface soil with a layer of impervious material or changing the nature of the soil so that it behaves as an impermeable medium.

(10) "Adverse water quality impacts" means any of the following adverse effects on the beneficial uses, as specified in Water Code section 13050(f) or adopted in a Water Quality Control Plan under article 3 of chapter 3 and/or article 3 of chapter 4 of division 7 of the Water Code, of the waters of the State, which include groundwater, fresh water, brackish water, marsh lands, wetlands, or coastal bodies or systems:
(A) Increase in biological oxygen demand;
(B) Increase in chemical oxygen demand;
(C) Increase in temperature;
(D) Increase in total dissolved solids; or
(E) Introduction of, or increase in, any of the following:
1. Priority toxic pollutants identified for California under section 303(c) of the federal Clean Water Act;
2. Pollutants listed by California or the Environmental Protection Agency for one or more water bodies in California under section 303(d) of the federal Clean Water Act;
3. Chemicals for which primary Maximum Contaminant Levels (MCLs) have been established under Health and Safety Code section 116365(a), or by the Environmental Protection Agency under the federal Safe Drinking Water Act;
4. Chemicals for which Notification Levels (NLs) have been specified under Health and Safety Code section 116455; or
5. Chemicals for which public health goals for drinking water have been published under the California Safe Drinking Water Act (commencing with Health and Safety Code section 116270).

M. Economic impacts.

Technical & Economic

1. What is the current approximate cost differential of raw material with original in % change, if known (e.g. 5% more, 10% less)?
   If more, what is the expected time to cost parity with original?

What is the current approximate cost differential of typical product using alternative in % change, if known (e.g. 5% more, 10% less)?

Environmental Fate & Human Health

2. Environmental Fate

i.

b. Soil

i. If the alternative is a chemical, is the log K_{OW} > 4.5?
☐ Not applicable
☐ No
☐ Yes
If yes, complete the Soil Worksheet.

ii. If the alternative is a chemical, is the aqueous solubility >1mg/L at any pH?
☐ Not applicable
☐ No
☐ Yes
If yes, complete the Soil Worksheet.

iii. If the alternative is a chemical, is the half life in soil of the substance or any of its breakdown products >60 days?
☐ Not applicable
☐ No
☐ Yes
If yes, complete the Soil Worksheet.

iv. If the alternative is an organic chemical, is the mobility index > 0 (calculate with $K_{OM} = 0.66 \times K_{OW}^{1.03}$)?
☐ Not applicable
☐ No
☐ Yes
If yes, complete the Soil Worksheet.

v.

vi.

3. Human Health / Public Health

Note: comparative chemical hazard assessment should have already been done, with Benchmark 1s having been deselected.
EXCLUDES – food, food contact, drugs, pesticides (out of scope)

a. Under normal use conditions, would the product be expected to be applied directly to the skin (e.g. personal care products, household cleaning products) or handled frequently (e.g. cell phone)?
☐ No
☐ Yes
If yes, complete the Human Health and Occupational Exposure Worksheet.

b. Under normal use conditions, would the product be expected to be inhaled (e.g. hairspray, household cleaning products)?
☐ No
☐ Yes
If yes, complete the Human Health and Occupational Exposure Worksheet.

c. Under normal use conditions, would the product be expected to be used primarily by children under the age of 12?
☐ No
☐ Yes
If yes, complete the Human Health and Occupational Exposure Worksheet.

d. If the alternative is a chemical, does this product, its constituents, or any of its likely breakdown products meet any of the following criteria:
- Oral LD50 >50mg/kg
- Dermal LD50 >200 mg/kg
- Inhalation LD50 >0.5mg/L

☐ Not applicable
☐ No
☐ Yes
If yes, complete the Human Health and Occupational Exposure Worksheet.

e. If the alternative is a chemical, is this product, its constituents, or any of its likely breakdown products GHS Category 1A, 1B, or 2 for carcinogenicity?
☐ Not applicable
☐ No
☐ Yes
If yes, complete the Human Health and Occupational Exposure Worksheet.

f. If the alternative is a chemical, is this product, its constituents, or any of its likely breakdown products GHS Category 1A, 1B, or 2 for mutagenicity/genotoxocity?
☐ Not applicable
☐ No
☐ Yes
If yes, complete the Human Health and Occupational Exposure Worksheet.

g. If the alternative is a chemical, is this product, its constituents, or any of its likely breakdown products GHS Category 1A, 1B, or 2 for carcinogenicity?
☐ Not applicable
☐ No
☐ Yes

If yes, complete the Human Health and Occupational Exposure Worksheet.

h. If the alternative is a chemical, does this product, its constituents, or any of its likely breakdown products meet any of the following criteria:
- Oral repeated dose toxicity NOAEL/LOAEL < 30mg/kg-bw/day
- Dermal repeated dose toxicity NOAEL/LOAEL < 60mg/kg-bw/day
- Inhalation repeated dose toxicity NOAEL/LOAEL < 0.06 mg/L/6h/day

☐ Not applicable
☐ No
☐ Yes
If yes, complete the Human Health and Occupational Exposure Worksheet.

i. If the alternative is a chemical, is this product, its constituents, or any of its likely breakdown products GHS Category 1A or 1B for skin sensitization?
☐ Not applicable
☐ No
☐ Yes
If yes, complete the Human Health and Occupational Exposure Worksheet.

j. If the alternative is a chemical, is this product, its constituents, or any of its likely breakdown products GHS Category 1A or 1B for respiratory sensitization?
☐ Not applicable
☐ No
☐ Yes
If yes, complete the Human Health and Occupational Exposure Worksheet.

k. If the alternative is a chemical, is this product, its constituents, or any of its likely breakdown products GHS Category 1A or 1B for respiratory sensitization?
☐ Not applicable
☐ No
☐ Yes
If yes, complete the Human Health and Occupational Exposure Worksheet.

l. Etc. for
- Eye and skin irritation/corrosivity
- Endocrine activity
- Reproductive and Developmental Toxicity
- Additional GHS/physical end points, including explosivity, etc.

2.

Worksheets *(to be developed)*

Goal: identify potential unintended consequences in order to disqualify an alternative or to trigger risk reduction actions

- **Water Worksheet (includes Green Screen endpoints and logic)**
- **Soil Worksheet**
- **Air Worksheet**
- **Human Health and Occupational Safety (includes Green Screen endpoints and logic)**
- **Resources**