Incorporating life cycle screening into Alternatives Analysis

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Background

In 2013, the Safer Consumer Products Regulations went into effect in California to reduce the use of chemicals with negative human health and/or environmental impacts.

These Regulations require manufacturers to perform an Alternatives Analysis to identify and evaluate alternatives to Priority Products—products that pose high risk to human health and the environment.

This Analysis consists of two stages. The First Stage focuses on screening alternatives and identifying factors that are relevant to consider in a thorough investigation of alternatives during the Second Stage. The Alternatives Analysis requires the incorporation of life cycle thinking to account for impacts throughout the production, use, and disposal of a product.

Life cycle assessments are time-consuming and data-intensive. Furthermore, many companies, particularly small ones, lack the technical expertise to conduct such assessments. Thus, there is a need for a framework to incorporate life cycle thinking into the First Stage of an Alternatives Analysis in a constrained time frame.

Generic life cycle phases of a product. Note, not all phases are shown.

Objectives

1. To develop a life cycle alternatives screening framework and test the framework with a case study of methylene chloride in paint strippers and alternatives.

2. To design a document explaining the steps needed to implement the life cycle screening framework for a particular product and a visual presentation to communicate the results to public and corporate audiences.

Approach

Relevant literature was reviewed to provide a background on Alternatives Assessment, Life Cycle Assessment, and hotspotting analysis. The developed framework made use of valuable aspects of each of these separate methodologies.

To inform and test the framework, a case study was performed. Methylene chloride in paint stripper was chosen as an appropriate Priority Product because of the availability of both chemical substitutes (e.g. benzyl alcohol-based paint stripper) and full process substitutes (e.g. sanding). The combination of these alternatives ensured that the developed framework was applicable to both formulated and composite products.

Data sources for the case study included government (e.g. US EPA) and non-government agencies (e.g. Material Safety Data Sheets). These sources provided both qualitative and quantitative data on human health, environmental, and waste/end-of-life impacts.

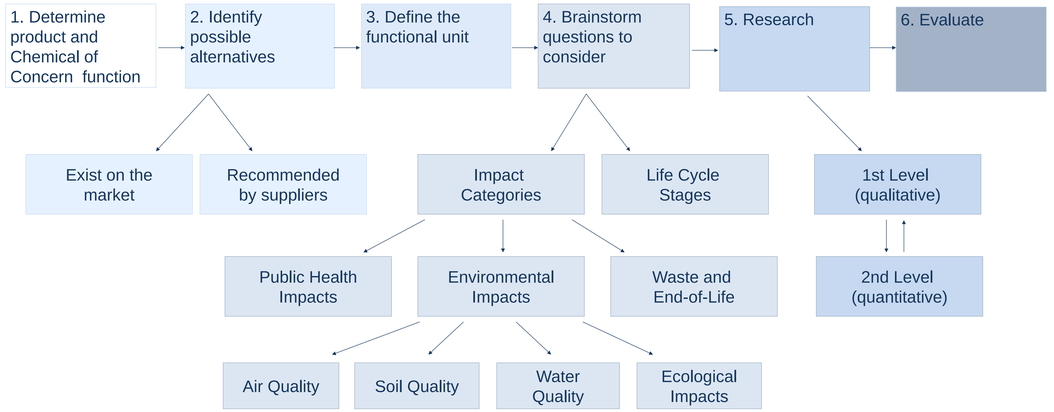
Examples of paint stripper products

Results

1. Framework

Our framework outlines an approach for incorporating life cycle thinking into a First Stage Alternatives Analysis, as set forth in the Safer Consumer Products Regulations.

The framework consists of six primary steps.



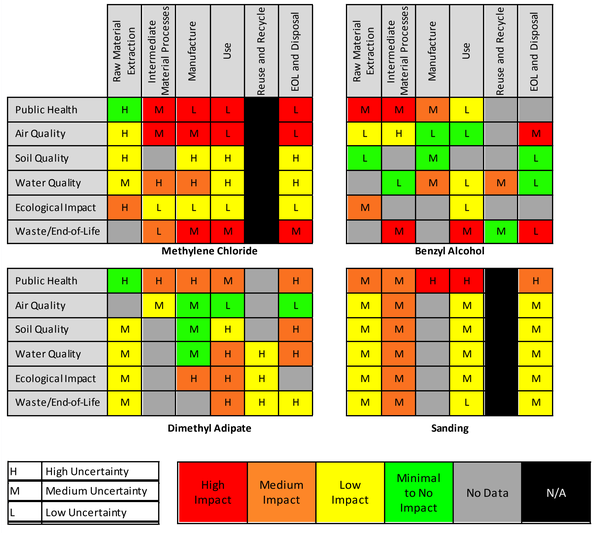
2. Visualization

The data gathered by following the framework requires a user-friendly visualization to achieve two of the goals of a First Stage Alternatives Analysis: (1) screen alternatives; and (2) identify factors that are relevant for consideration in a Second Stage Alternatives Analysis. Evaluation criteria were used to assess the severity of impacts. Each impact level—minimal to no, low, medium, and high—was assigned a color for visualization.

A series of heat maps was used to present the results of the case study on paint strippers and to illustrate how this visualization tool can be useful to decision-makers.

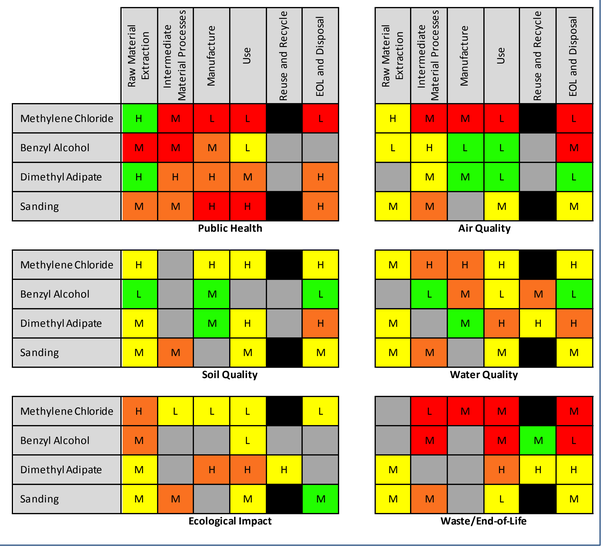
Screening Alternatives

To identify alternatives that can be screened out from further consideration, evaluations were presented as product-specific heat maps. This presentation of the evaluation allows for the identification of alternatives that have an overall similar or worse level of impact than the Priority Product.



Identifying Relevant Factors

To help identify factors relevant for consideration, the evaluation was presented as a series of impact-specific heat maps. This format allows for an easier comparison of alternatives for specific impacts to determine whether a more in-depth investigation of a particular impact is warranted.

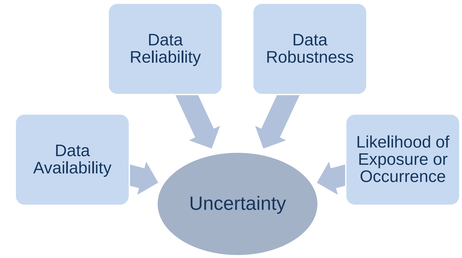


Data Uncertainty

The paint stripper case study demonstrated that there are multiple elements to assessing data uncertainty in a life cycle screening.

Data quality is a result of the availability, reliability, and robustness of data. An additional consideration that is important to the screening process is the likelihood of a particular exposure scenario or a particular impact occurring.

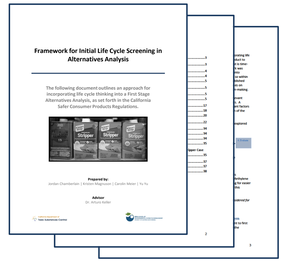
The developed framework does not currently include quantitative methods for assessing uncertainty.



Conclusions

A new framework was developed and tested using a case study of methylene chloride-based paint strippers and three alternatives. It incorporates critical aspects from Alternatives Assessment, LCA methods, and hotspot analysis, and is applicable to both formulated and composite products.

The framework introduces life cycle concepts to a non-expert audience as a way to achieve the objectives of a First Stage Alternatives Analysis to: (1) identify alternatives; (2) screen alternatives; and (3) identify relevant factors to consider in a Second Stage Alternatives Analysis. This framework successfully addresses these three objectives. The second step of the framework presents a process for identifying alternatives, and the final step introduces a visualization tool to screen alternatives and aid in identifying relevant factors.



Sample pages from the framework document

This framework was tailored to the Safer Consumer Products Regulations. It focuses on introducing the concepts of life cycle thinking and suggests an approach to incorporate these considerations quickly. This framework is malleable, and additional impacts, such as economic or social impacts, could be incorporated into this model.

Next Steps

1. Further develop quantitative methods for life cycle screening using the paint stripper case study.

2. Develop framework for Second Stage Alternatives Analysis.

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