

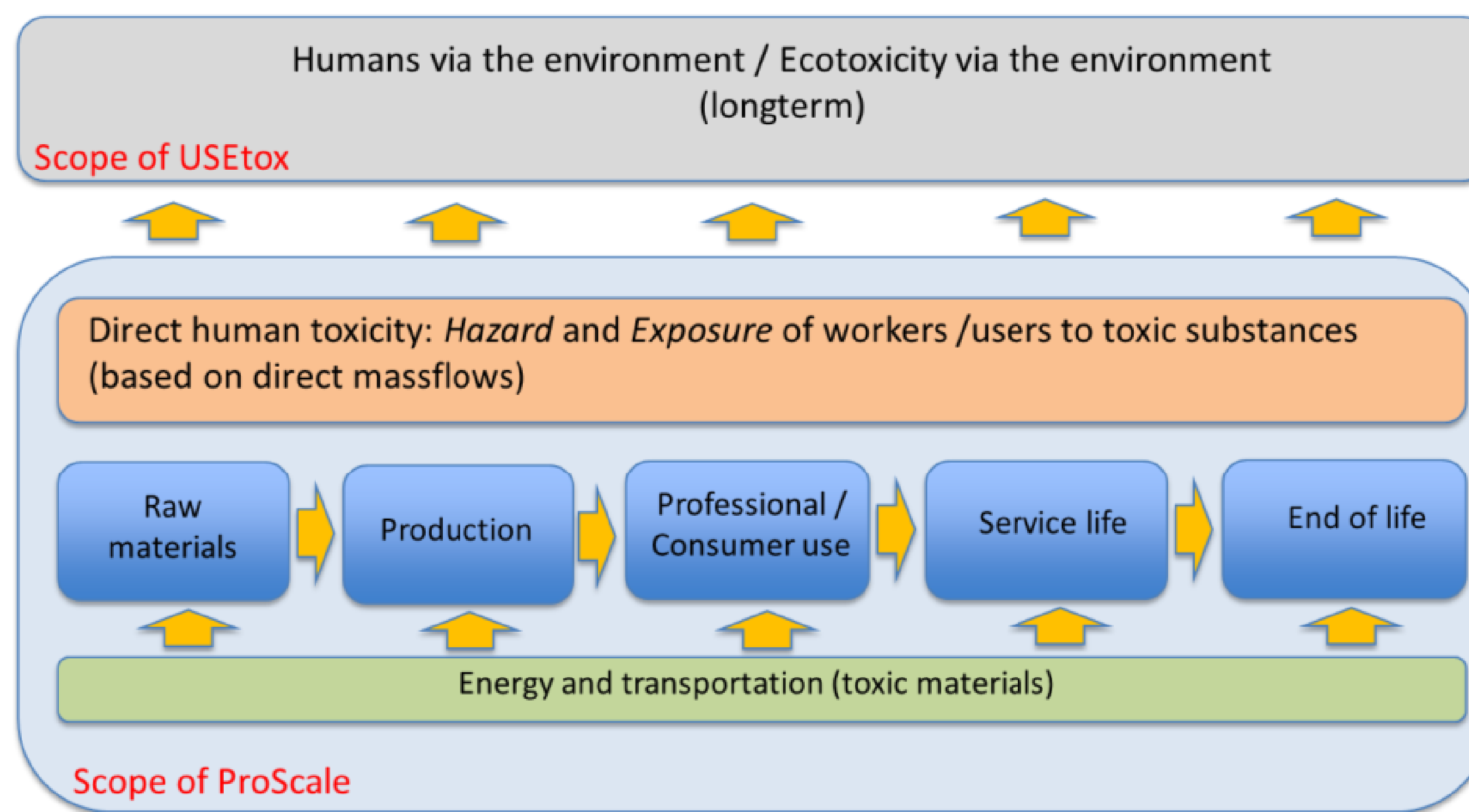
P26-02: Global Human Toxicity Potential assessed with the ProScale method for use in Normalisation in LCA

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INTRODUCTION

Typically, methods used in life cycle assessment (LCA) to assess human toxicity impacts are only focusing on the indirect impact of chemicals emitted into the environment (e.g. USEtox). ProScale was, therefore, developed as a method to cover toxicity potentials due to direct chemical exposure to workers, professionals and consumers associated with products in a life cycle perspective (Figure 1) [1].

Examples of applying ProScale are emerging [2,3], showing that the method works and can be integrated into LCA. But in order to align with other impact assessment approaches for the benefit of LCA and PEF practitioners, there is also a need for a global normalisation score [4] for ProScale. The study described here presents the results of the first calculation of two such Normalisation scores for ProScale, inhalation and dermal.



Objectives

The goal of this study was to:

- Assess two calculations of two Normalisation scores for ProScale, inhalation and dermal.
- Identify for both inhalation and dermal exposure routes which processes in petrochemistry and plastics that have the largest contribution to direct human toxicity potential.

Method

The ProScale methodology can in a simplified way be described using Equation 1, where:

- PSS = ProScale Score for a material/chemical present in a process
- HF = Hazard Factor
- ECF = Exposure Concentration Factor
- PHF = Person-Hour Factor
- MF = Mass Flow

$$PSS = HF \times ECF \times PHF \times MF \quad (1)$$

As ProScale is a novel method, a data set for each individual unit process had to be developed from scratch. A data base has been created and is being populated in order to simplify for other practitioners, concurrent to building up product systems and carrying out assessments.

Studied systems and results

Figure 2 shows the studied system for petrochemistry and plastics calculated for the two Normalisation scores for ProScale, inhalation and dermal. For about 60 individual processes, ProScale scores for inhalation and dermal exposure were calculated. For the global Normalisation score, the focus was on petrochemistry and plastics. Then, the global annual production, or in some cases production capacity, was identified through a range of literature sources, normally covering a year in the period 2015-2018.

Key findings

- Activities contributing mostly to the ProScale score: crude oil extraction and oil refining for inhalation.
- The result for dermal shows a very similar pattern to inhalation, but the second largest activity is steam cracking.

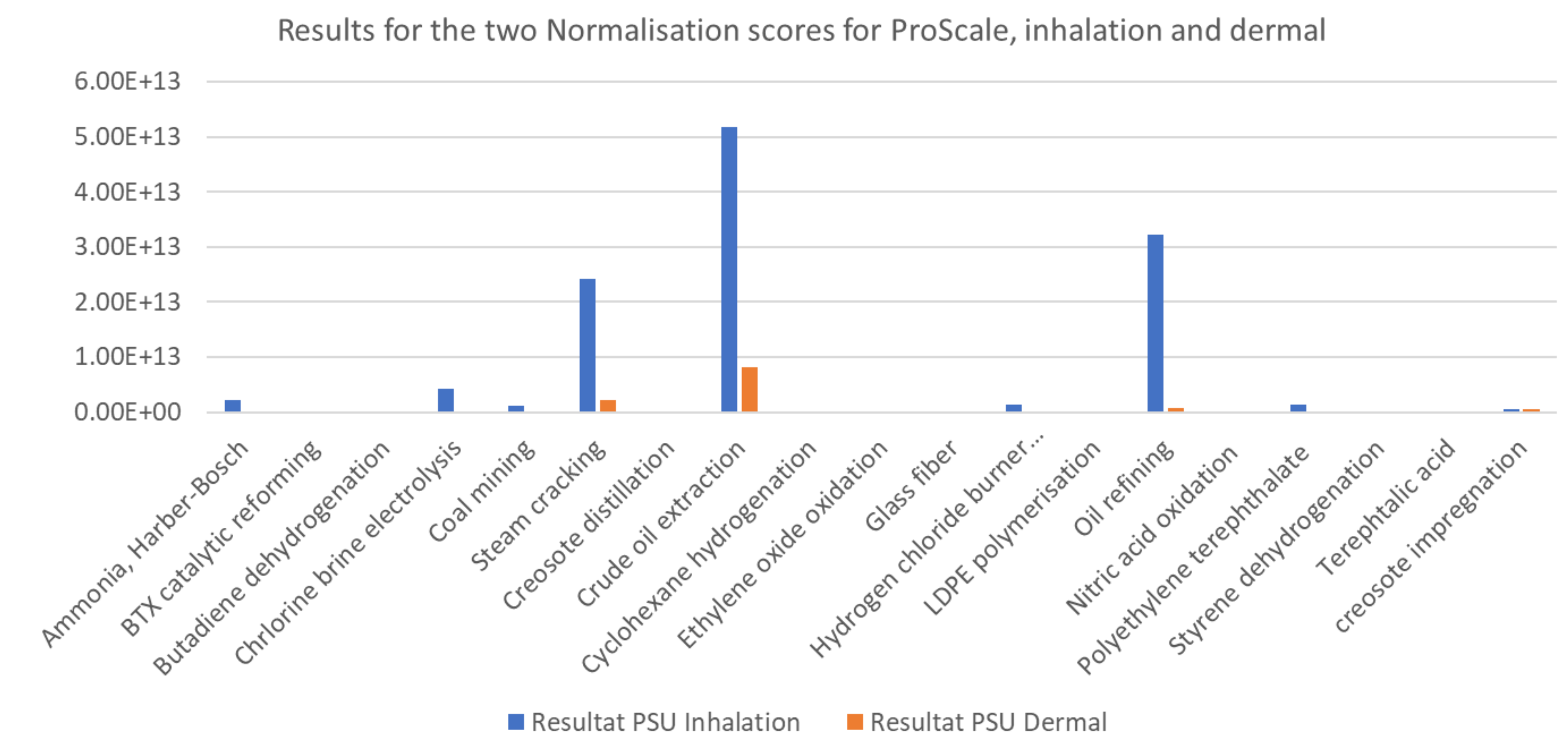


Figure 2: Graph showing the studied system for petrochemistry and plastics calculated for the two Normalisation scores for ProScale, inhalation (in blue) and dermal (in orange).

Discussion

As a first version of normalisation scores, the numbers calculated here could be used, but cover a limited part of the global economy. Possibly important other processes are for example metal production processes.

The domain of residential exposure from building material is also not included at this point. This may mean that when using these scores in regular LCA projects, direct human toxicity potential as calculated with ProScale will potentially be slightly overestimated. Further work is planned to elaborate the issue further.

CONCLUSIONS AND OUTLOOK

- The resulting Normalisation scores are:
 - ProScale(inhalation): 1.2E+14 ProScale points
 - ProScale(dermal): 1.2E+13 ProScale points.
- Among the assessed and included processes, the three dominating processes are crude oil extraction (43% and 69% for inhalation and dermal, respectively), crude oil refining (27/7) and steam cracking (20/18).
- It should be noted that essentially only petrochemical sector activities are included. For example metal mining, extraction and processing could also be important contributors to be further investigated
- The results may still serve as a first set of normalisation scores

References

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