

## Abstract

The Product Use Scheduler (PUS) is the second of three modules in the Combined Human Exposure Model (CHEM), which estimates exposure from consumer products. PUS accepts an .csv input file (normally from the Residential Population Generator, RPSGen). The module returns diaries of product use, which are passed to Source-to-Dose (S2D) in CHEM. Diaries are 364 days long, seasonal, and have rules based on the type of product, clusters, the characteristics of the household, and the age of the user. Differences in Product Use Categories are demonstrated using a case example of owners and renters.

## Features

### Clusters

Some products are oftentimes used together (toothpaste, shower gel, conditioner). These are paired in PUS to create realistic diaries.

### Seasonality

In the 364-day diary, children are home from school in summer, impacting the use patterns (Brandon et al., 2018).

### Communal

Some products pertain to the entire household. For example, a spray cleaner, if used, will benefit the entire household, and only one individual partakes in this activity per household.

### Age

Children aged 0-12 do not use communal products, and 0-5 are assigned a different suite of consumer products.

### Ever/Never

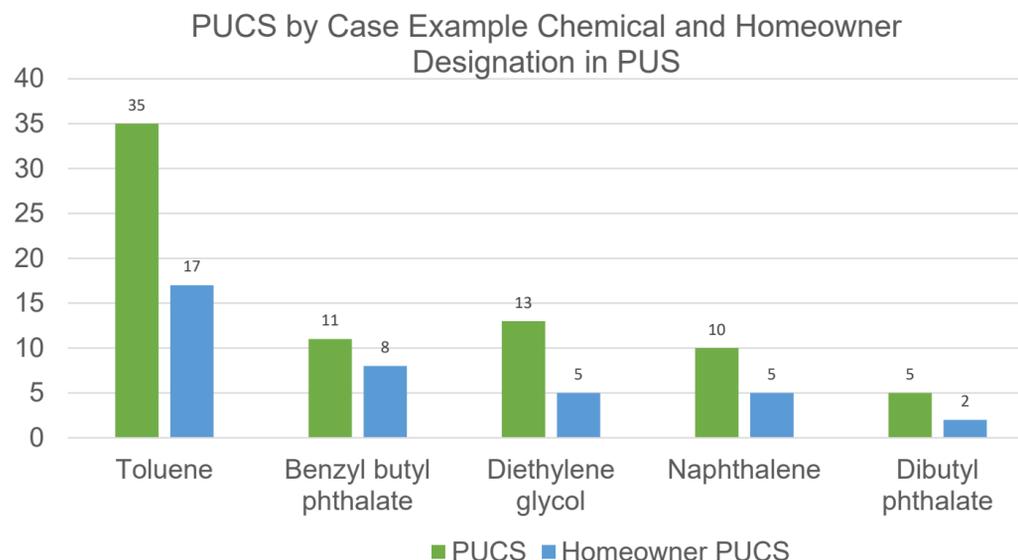
Some products are influenced by the characteristics of the household: if a home has a lawn, there are lawn care product uses scheduled. However, if the household does not have a lawn, it is assumed that the individuals never use lawn care products.

## Methods

Product Use Scheduler is built as a dynamic tool to fit different assumptions and scenarios. To demonstrate the difference in exposure between homeowners and those without, a subset of 'Homeowning PUCs' was selected by modifying the input file FullENT.csv per the instruction in the Technical Manual (Dionisio et al., 2018). Five chemicals which were included in Product Use were selected: Benzyl butyl phthalate, Dibutyl phthalate, Diethylene glycol, Toluene, and Naphthalene.

## Results & Discussion

Figure 1. Proportion of PUCs influenced by Home ownership in PUS.



In Figure 1, the proportion of Homeowner PUCs for each of the 5 case examples are shown. Toluene is the most prevalent chemical and has 17 of 35 PUCs corresponding to the household. Dibutyl phthalate is in only 5 PUCs, 2 of which are influenced by the homeowner ever/never rules. However, because PUCs are not equally assigned (some are scheduled more frequently than others), presence in a PUC does not relate specifically to exposure.

The selected chemicals pertaining to household ownership are in Table 1. These mostly include home improvement and care (caulk, surfacing, stain cleaning, finishing), as it was assumed that a specialist would perform these tasks in a rented residence.

Table 1. Product Use IDs associations with chemicals, product, and case example chemicals.

| PUCID             | Chemicals | Products | Description   | Cases   |
|-------------------|-----------|----------|---|---|
| HM.0100.020.099.F | 58        | 65       | adhesives and adhesive removers , multipurpose adhesive NOC | Dibutyl phthalate, Toluene                                      |
| HM.0100.030.099.F | 3         | 3        | adhesives and adhesive removers , wood adhesive NOC         | Toluene   |
| HM.0400.010.099.F | 40        | 31       | caulk/sealant , caulk/sealant NOC                           | Benzyl butyl phthalate, Toluene                                 |
| HM.0600.010.050.F | 13        | 6        | corrosion protection , corrosion protection spray           | Toluene   |
| HM.0800.010.050.F | 13        | 5        | finish , finish spray                                       | Benzyl butyl phthalate, Toluene                                 |
| HM.0800.010.099.F | 28        | 14       | finish , finish NOC   | Naphthalene, Toluene  |
| HM.1400.010.040.F | 23        | 57       | paint/stain and related products , paint exterior           | Benzyl butyl phthalate, Diethylene glycol, Toluene              |
| HM.1400.010.041.F | 14        | 85       | paint/stain and related products , paint interior           | Diethylene glycol   |
| HM.1400.010.050.F | 39        | 126      | paint/stain and related products , paint spray              | Dibutyl phthalate, Toluene                                      |
| HM.1400.010.099.F | 30        | 87       | paint/stain and related products , paint NOC                | Benzyl butyl phthalate, Diethylene glycol, Naphthalene, Toluene |
| HM.1400.020.099.F | 15        | 6        | paint/stain and related products , paint cleaner NOC        | Toluene   |
| HM.1400.040.099.F | 10        | 7        | paint/stain and related products , paint thinner NOC        | Toluene   |
| HM.1400.050.050.F | 5         | 4        | paint/stain and related products , primer spray             | Toluene   |
| HM.1400.050.099.F | 16        | 8        | paint/stain and related products , primer NOC               | Benzyl butyl phthalate, Naphthalene, Toluene                    |
| HM.1400.070.099.F | 15        | 15       | paint/stain and related products , stripper NOC             | Toluene   |
| HM.1500.020.099.F | 5         | 3        | patch and repair , putty or filler NOC                      | Benzyl butyl phthalate  |
| HM.2000.040.050.F | 6         | 1        | surface sealers , surface sealer spray                      | Benzyl butyl phthalate, Toluene                                 |
| HM.2100.010.099.F | 6         | 2        | tiling , grout sealer NOC                                   | Benzyl butyl phthalate  |
| LY.0200.010.099.F | 26        | 20       | grill/camping fuel , grill/camping fuel NOC                 | Diethylene glycol, Naphthalene, Toluene                         |
| VE.0200.040.099.F | 22        | 3        | boat care and maintenance , boat engine fluids NOC          | Diethylene glycol, Naphthalene, Toluene                         |

## References

- Brandon, N., Dionisio, K., Isaacs, K., Tornero-Velez, R., Kapraun, D., Setzer, R., & Price, P. (2018). Simulating exposure-related behaviors using agent-based models embedded with needs-based artificial intelligence. *Journal of Exposure Science & Environmental Epidemiology*, 30, 184 - 193.
- Dionisio, K., Hong, T., Lefebvre, J., Arun, V. (2018, September). *Product Use Scheduler Module Technical Manual*. EPA. [https://github.com/HumanExposure/HEM-Documentation/blob/master/ProdUseSched\\_TechMan\\_2018Sept11.pdf](https://github.com/HumanExposure/HEM-Documentation/blob/master/ProdUseSched_TechMan_2018Sept11.pdf)