The Product Use Scheduler: A Component in the Combined Human Exposure Model (CHEM)
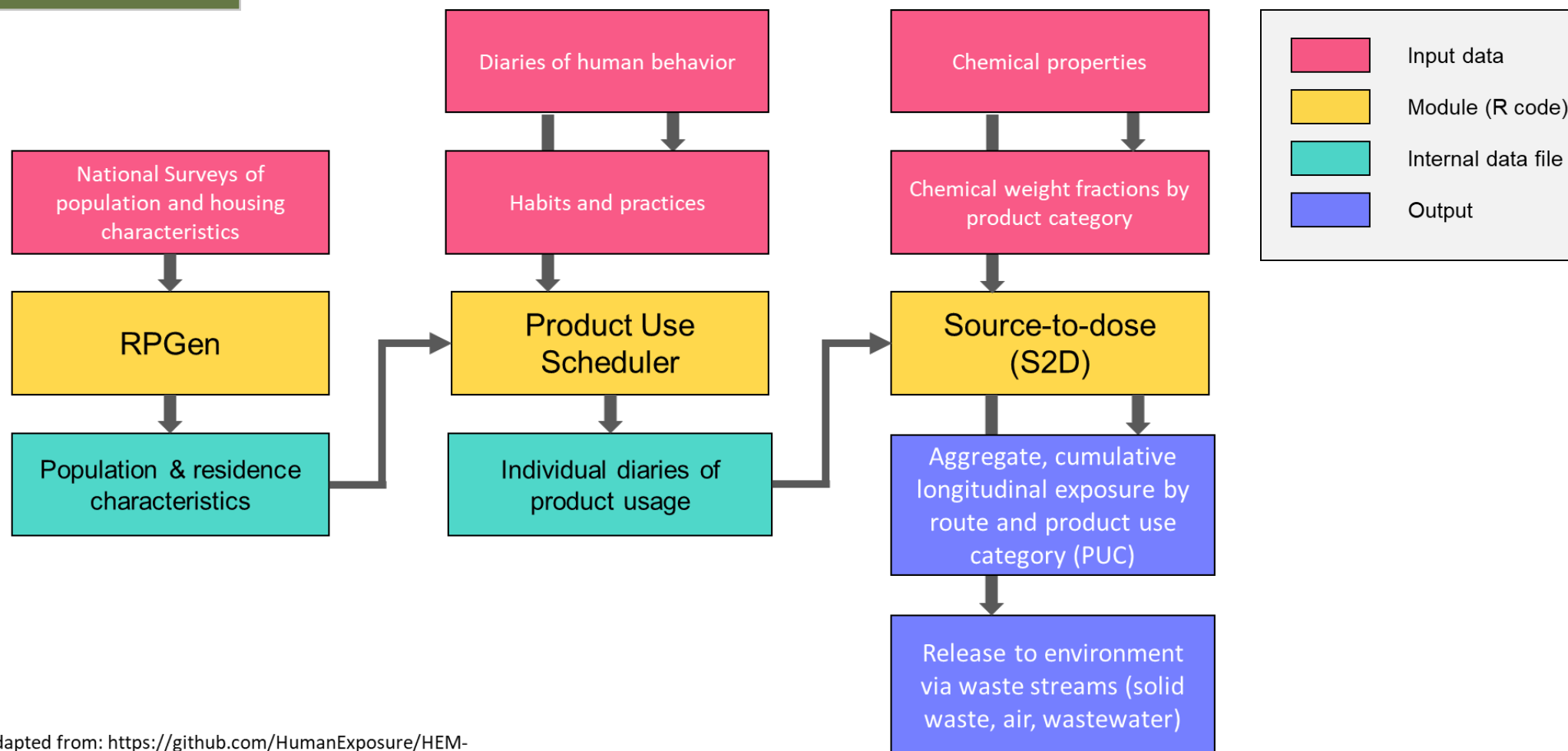
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Outline

- Role of Product Use Scheduler (PUS) in CHEM

- How the module works

- Continuation of Homeowners Case Study

- Conclusion

adapted from: https://github.com/HumanExposure/HEM-Documentation/blob/master/HEM_UserGuide_2018August28.pdf

Inputs

Input	Source	Description	Number of Records
FullENT.csv	Written for PUS	Determines ever/never rules.	224 (one for Each PUCID)
PUC_use_data.csv	Table 8 of Isaacs et al. 2014	Assigns clusters, defines use parameters in the population (frequency, mass)	546
Activity_diary_pool.rds	Agent-Based Model of Human Activity Patterns (ABMHAP) (Brandon, Dionisio et al. 2018)	Contains example behavior diaries for working adults, not working adults, school age children, and younger than school age children with four behavior patterns: sleeping, working/school, commuting, and 'other.' Diaries are written for 364 days, or one year.	1024 activity diaries, 256 per group.
Pophouse.csv	RPGen	Contains 126 variables describing a population with housing, residential, demographic, and physiological characteristics. add required columns	RPGen user determined

Outputs

Input	Description	Number of Records
Household folders	Product use diary for each household member for each day for a year with durations, product types, mass of products, product cluster, gender, and age.	User selected

Benefits of Product Use Scheduler

Seasonal

- Children do not attend school in the summer
- Products are associated with seasonality

Aggregate

- Inclusive of numerous products and categories

Longitudinal

- Exposure estimates vary depending on patterns and behavior (working adults, nonworking, school age children, young children)

Clusters

Some products are clustered into groups when used in conjunction, such as laundry materials.

- shampoo, toothpaste and soap
- laundry detergent, softener, dryer sheets

Communal Products

Some products are only used once per person in the household:

- Once one member of the household has performed an act (mowed the lawn/cleaned the kitchen), other members do not

Some activities are defined by age and gender:

- Ages 5-12 only use personal products

- Males use 66% of outdoor-related communal products

- Females use 75% of indoor-related communal products

- If two or more adults of the same gender are present in a household, the usage is split equally amongst them.

Ever Never Rules

It was determined that some products would never be used given characteristics of a household.

- If a household does not have a pool, there are no product use categories assigned to pool cleaners.
- If a household does not have a dishwasher a different suite of products and activities are selected in product use.

- *If a household is owned, it was determined that the owner would do all repairs, many of which require consumer products (paint/stain/finish/caulk). However, it was determined that renters do not partake in this uses, as they would call a specialist.*

Generic PUS Flow
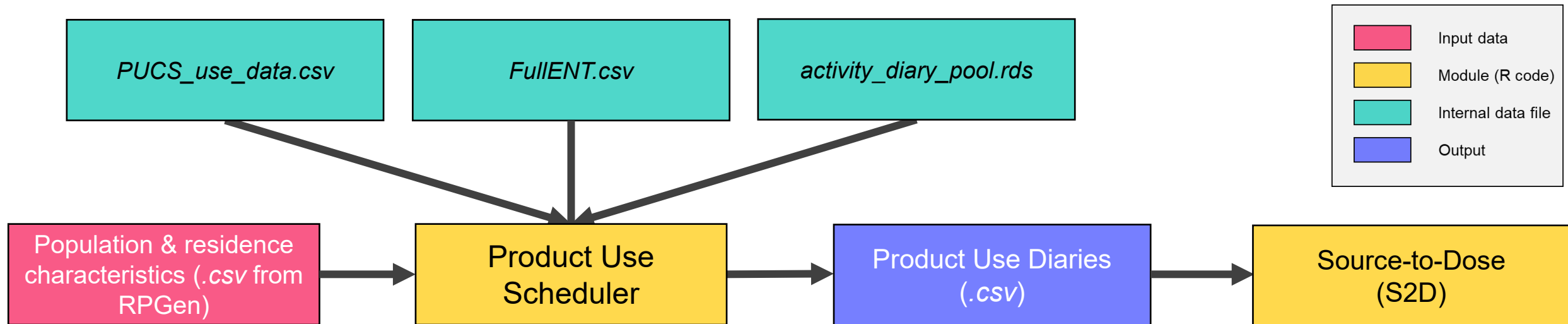
Modifying the Inputs Example 1: *RPGen*

- PUS requires 15 variables from RPGen that inform product use describing demographics (age/gender) and the household (baths, lot size, swimming pool)
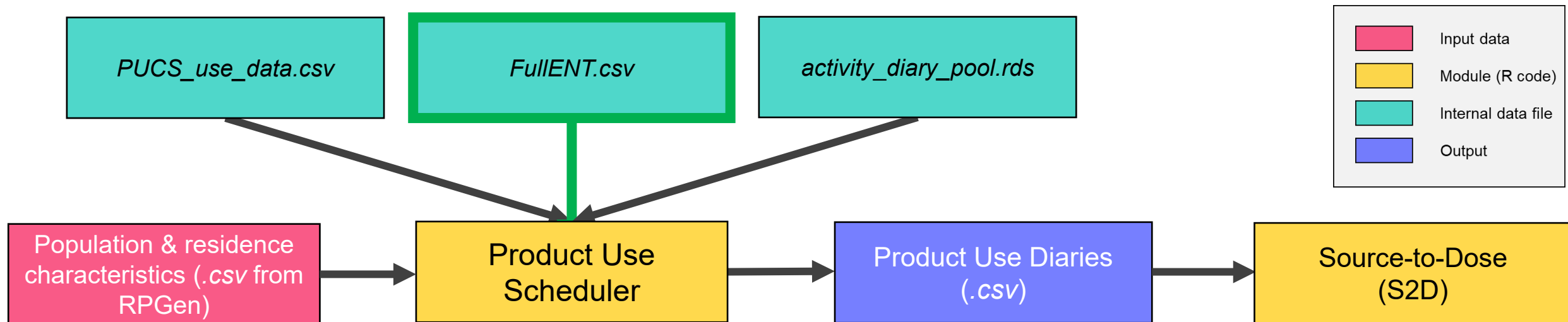- A more location granular population can supplant other variables.
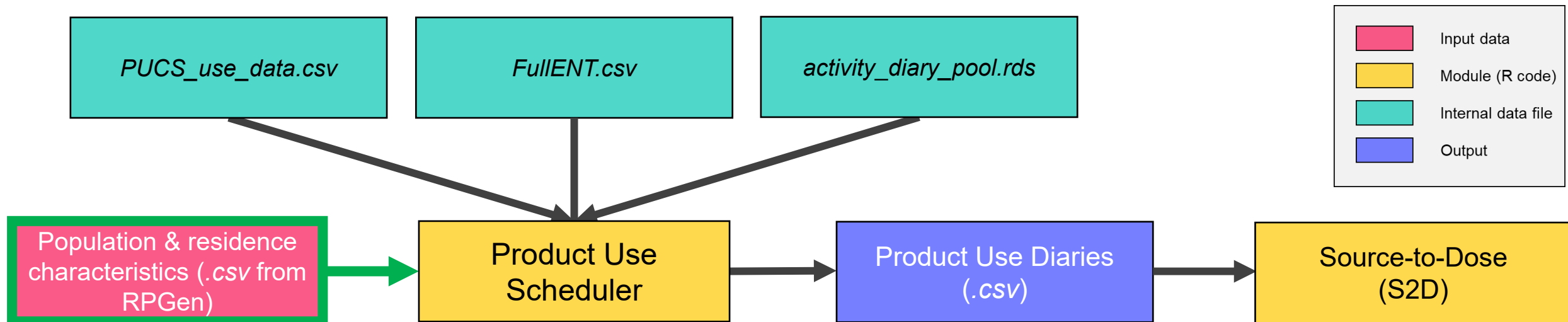
Modifying the Inputs Example 2: *Ever/Never Rules*

- The Input file FullENT.csv aligns product use codes with *ever/never* rules.
- It can be easily modified for different product use scenarios.
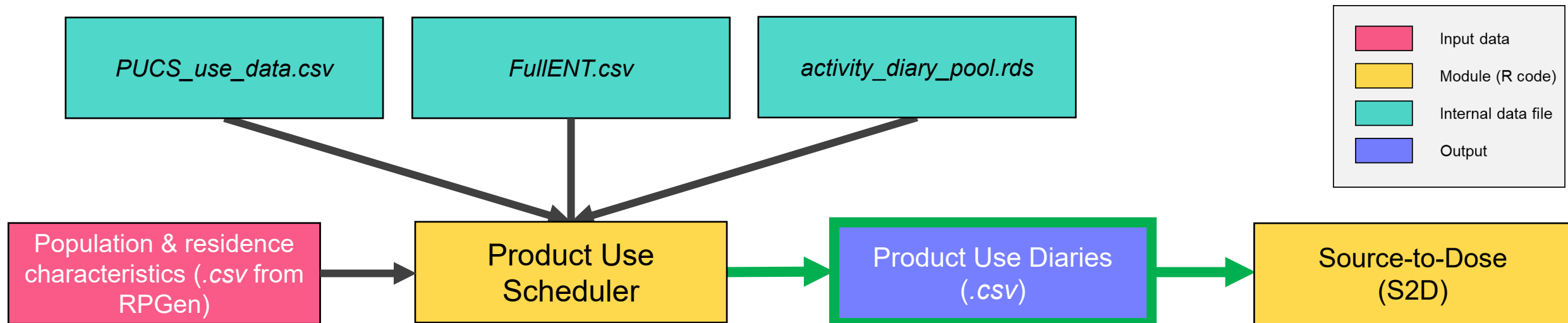
Modifying the Inputs Example 3: *Diary Output*

- Changing habits and practices can be done manually as well:
    - Are habits/ household characteristics really *ever/never* (Fireplace)?
    - Removal of commute (Work from home)?

Owner Specific Product Uses

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

Owner Specific Product Uses

PUCS by Case Example Chemical and Homeowner Designation in CHEM
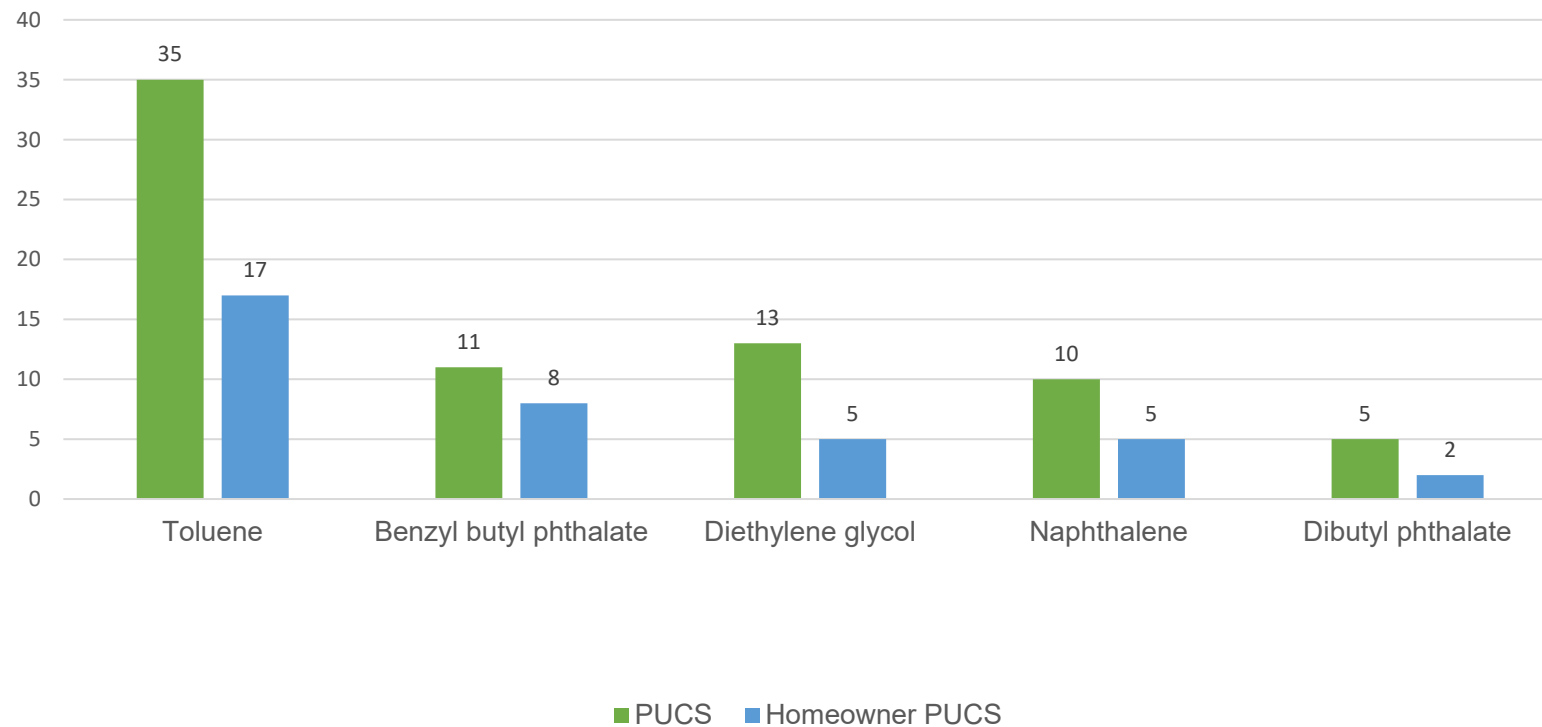
Keeping up with the Case Study
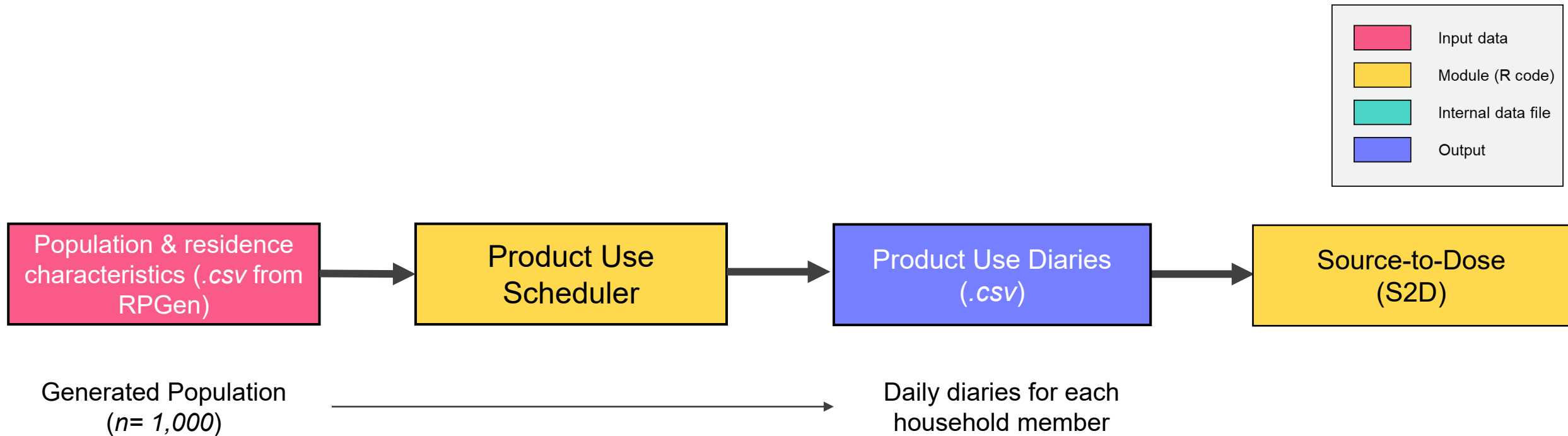
Input data	(pink)
Module (R code)	(yellow)
Internal data file	(teal)
Output	(purple)

Population & residence characteristics (*.csv* from RPGen) → Product Use Scheduler → Product Use Diaries (*.csv*) → Source-to-Dose (S2D)

Generated Population (*n= 1,000*) → Daily diaries for each household member

Conclusion

- The Product Use Scheduler (PUS) is the second module in the Combined Human Exposure Model (CHEM), which accepts a description of a population and households (RPGen) and creates dairies of product use for Source-to-Dose (S2D).

- Products are assigned based on use categories, determined by gender, age, group, clusters, and characteristics of the household

- PUS can be altered at the input, output, or internal level to address different populations, habits, and scenarios.

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