EPA United States Environmental Protection Agency

LCA HEM

Life Cycle Assessment

Human Exposure Modeling

Overview of EPA CSS Intramural Research on Life Cycle and Human Exposure Modeling (LC-HEM)

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NSMDS and NCCLC Grantees Meeting

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Office of Research and Development
Chemical Safety for Sustainability

Key Project Planning Team Members

Project Leads	National Risk Management Research Laboratory	National Exposure Research Laboratory
	Life Cycle Assessment	***Human Exposure and Dose Modeling***
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Sustainability Research Drivers

U.S. EPA Sustainability Research Strategy 2007

Long-Term Chemical and Biological Impacts

Improving our use of materials, shifting to environmentally preferable materials, and protecting human health all rely on assessing and eliminating the long-term impacts posed by harmful chemical and biological materials.

NRC Report: Sustainability and the EPA (the Green Book) 2011

How can the EPA decision-making process rooted in the environmental risk assessment/risk management paradigm be integrated into this new sustainability framework?

Program Research Drivers

Information and tools are needed by Agency Programs/Regions and States for more rapid evaluation of chemical safety across the life cycles of chemicals and products

- For OCSPP: chemical screening/prioritization, support chemical decision-making, and alternatives assessment
- For OSWER: support the Sustainable Materials Management Program that promotes life cycle perspective
- For Regions and States: support for alternatives assessment and green chemistry initiatives

Research Objectives

Develop a framework and database structure that brings together life cycle and chemical exposure modeling for more rapid assessments

Develop a user-friendly tool for evaluating chemical/product impacts in a life cycle assessment framework to support decision-making through improved risk and sustainability analysis

In partnership with Program/Region partners, develop and implement high priority/high interest case studies for demonstration and evaluation of the framework and tool

Success Will Include

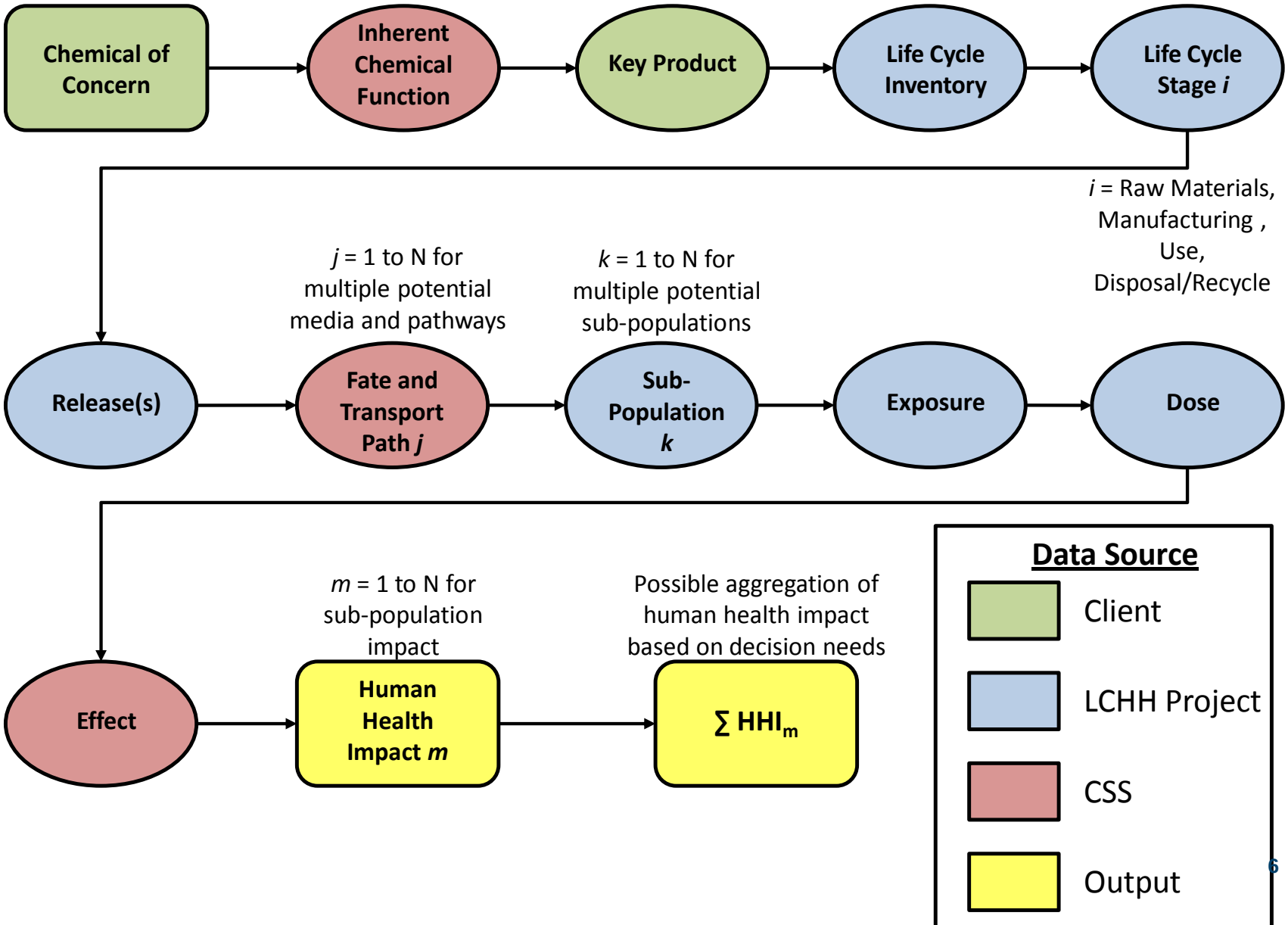
Improved human exposure modeling in life cycle assessments

Modeling and assessment for chemicals/products with less extensive data

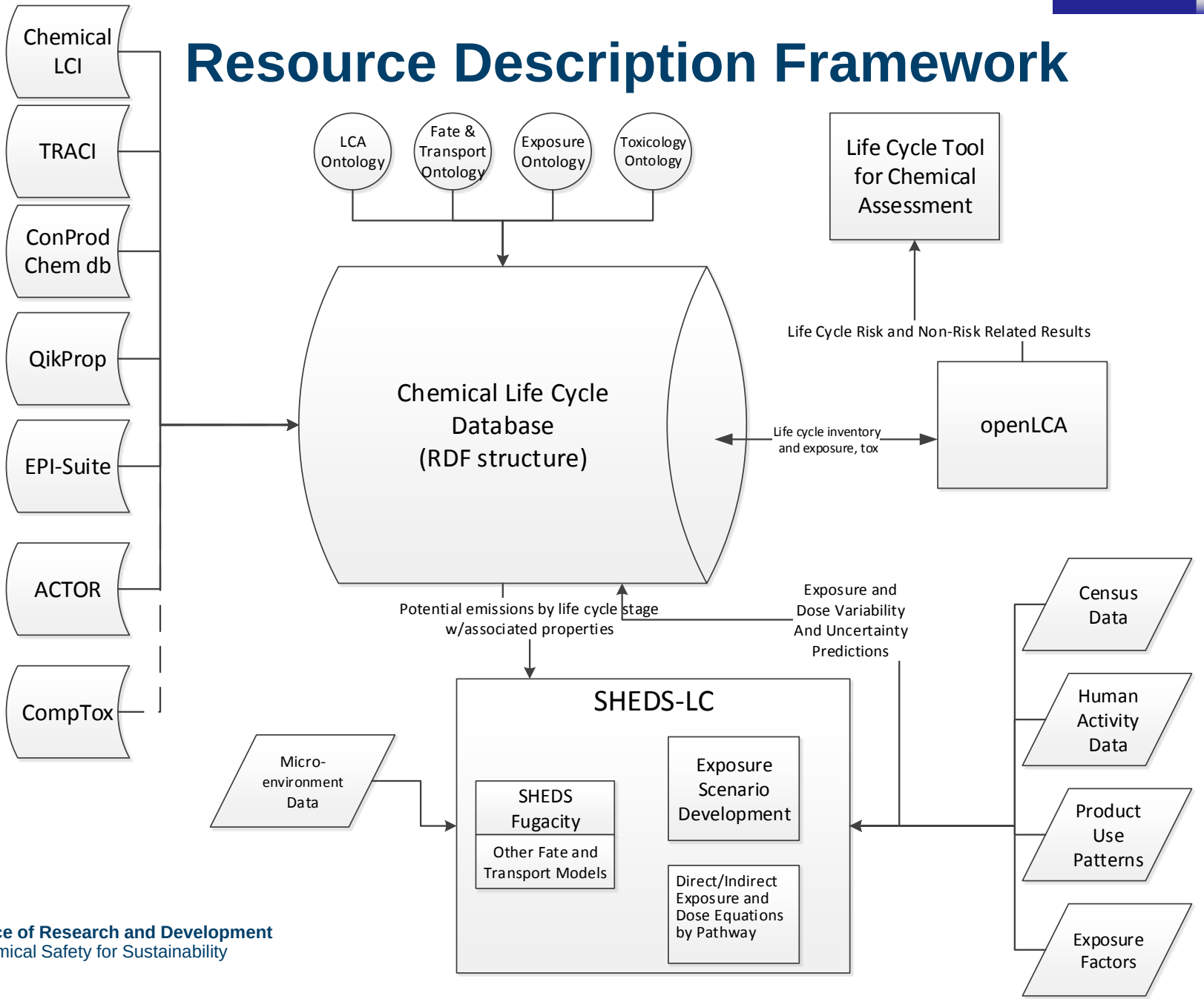
More rapid and higher throughput assessments

Life Cycle-Human Exposure Modeling (LC-HEM) tool usable by Offices/Regions and by external stakeholders

Life Cycle Human Health (LCHH) Assessment



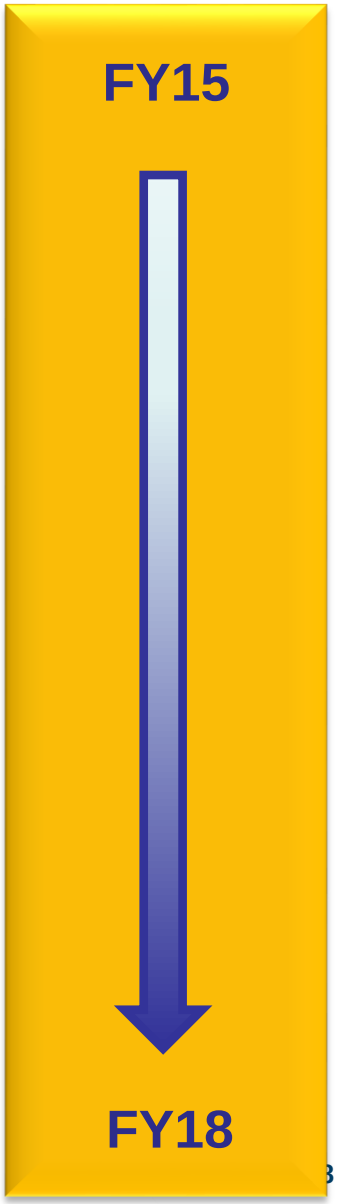
Resource Description Framework



Proposed Research Implementation

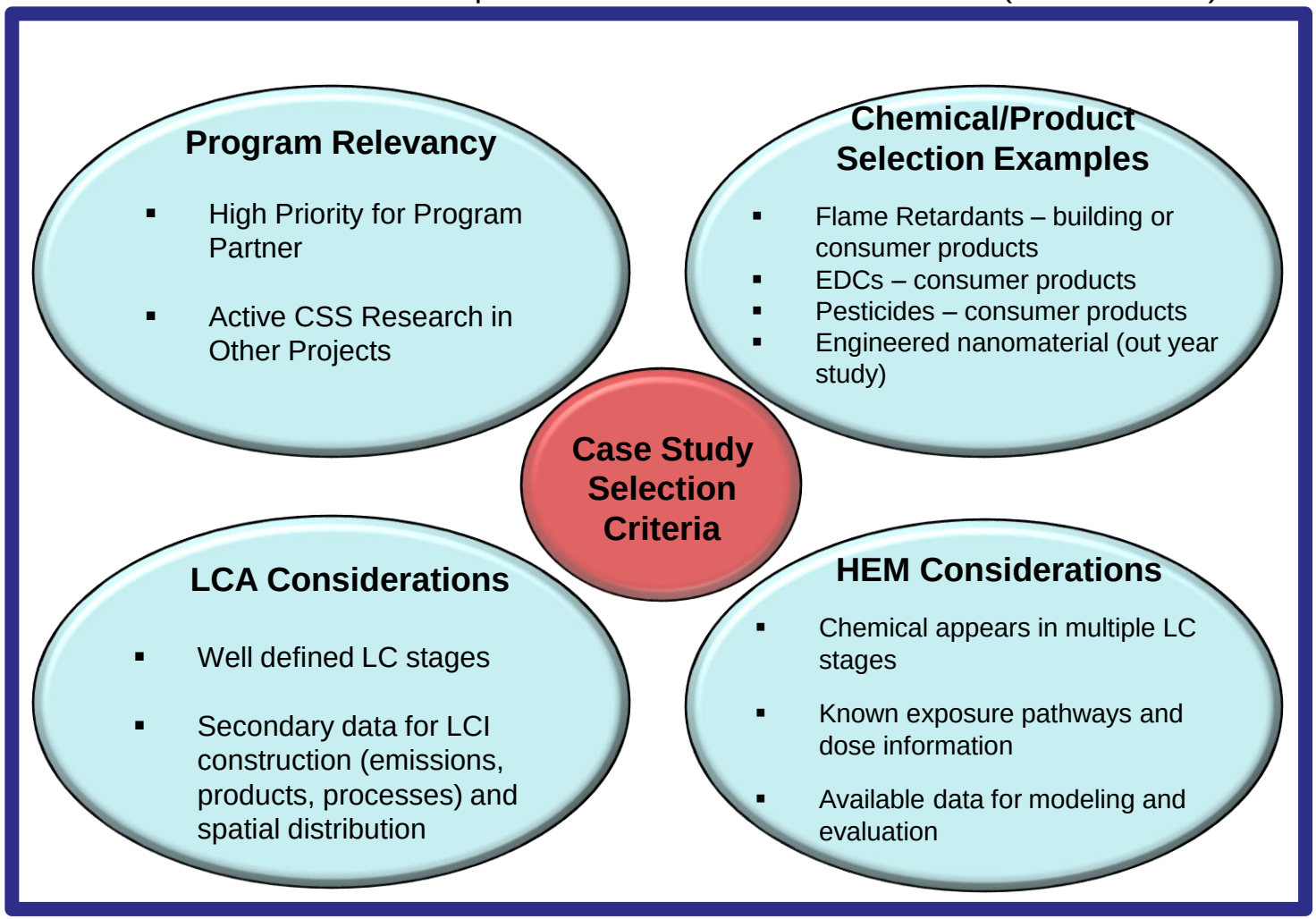
LCA HEM

- Task 1 – LC-HEM Conceptual Framework Development
- Task 2 – Case Study for Demonstration and Evaluation
- Task 3 – Resource Description Framework Development
- Task 4 – SHEDS-Life Cycle Development & Evaluation
- Task 5 – Rapid Estimation of Life Cycle Inventory
- Task 6 – Development of Beta LC-HEM Tool
- Task 7 – Case Studies for Demonstration and Evaluation



Case Studies for Demonstration and Evaluation

Initial Case Study – Develop/Assess Framework (FY16)
Two Case Studies – Implement/Assess beta-LC-HEM Tool (FY17 – FY18)

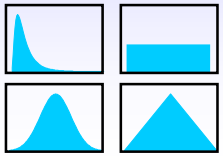


Stochastic Human Exposure and Dose Simulation Model (SHEDS)

Input Databases

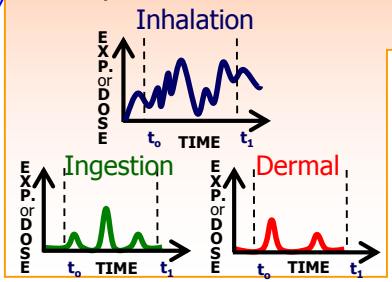
- Human Activity
- Ambient Conc.
- Food Residues
- Recipe/Food Diary

Exposure Factor Distributions



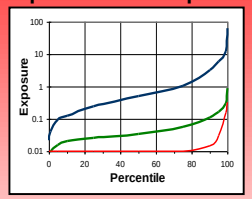
Algorithms

- Calculate Individual Exposure/Dose Profile

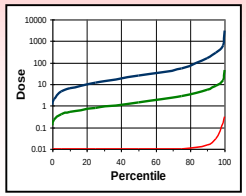


Output

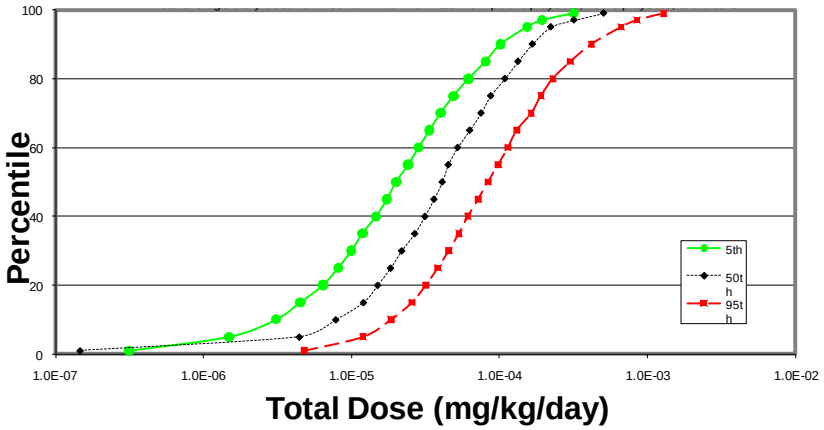
- Population Exposure



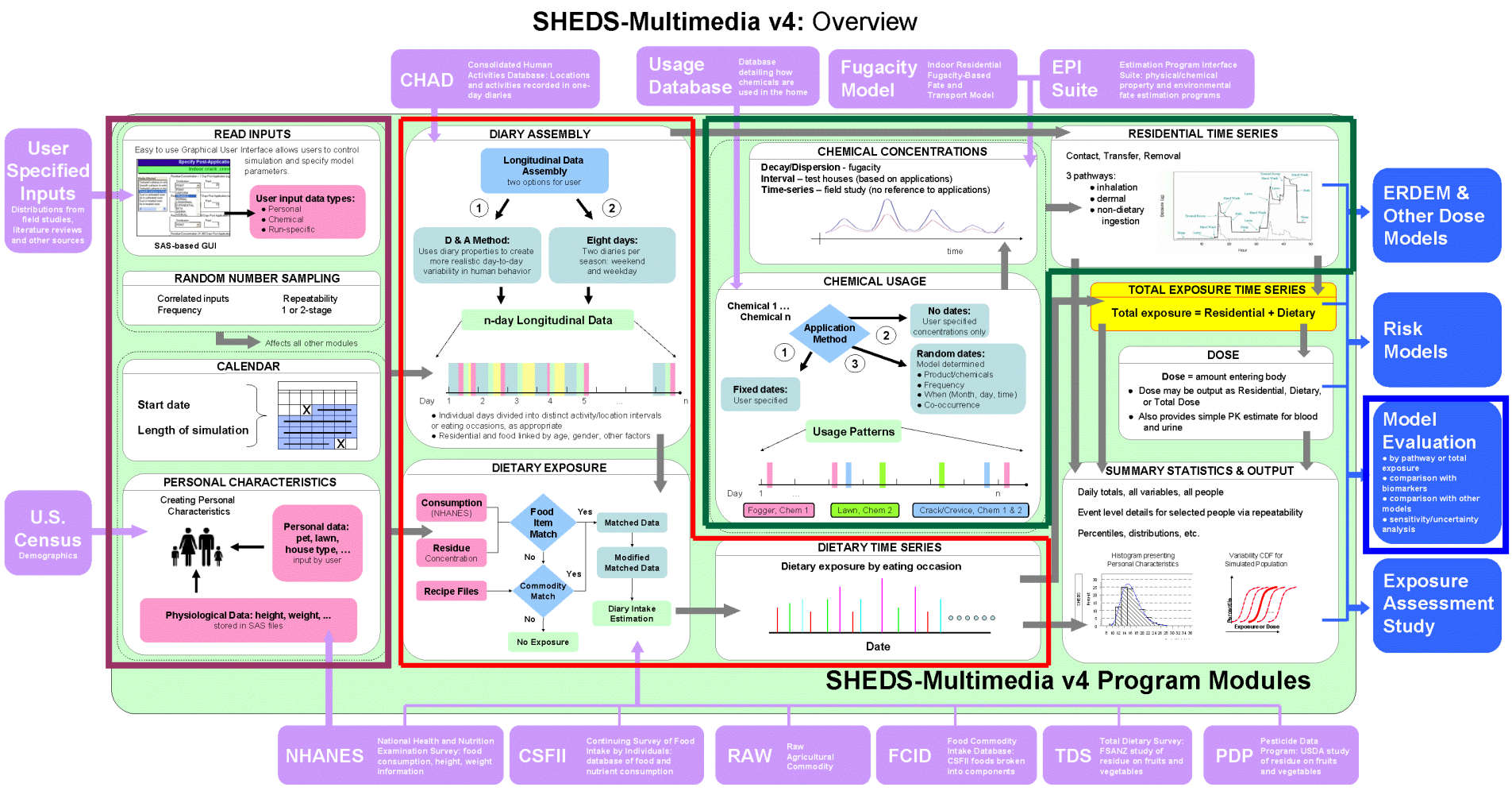
- Population Dose



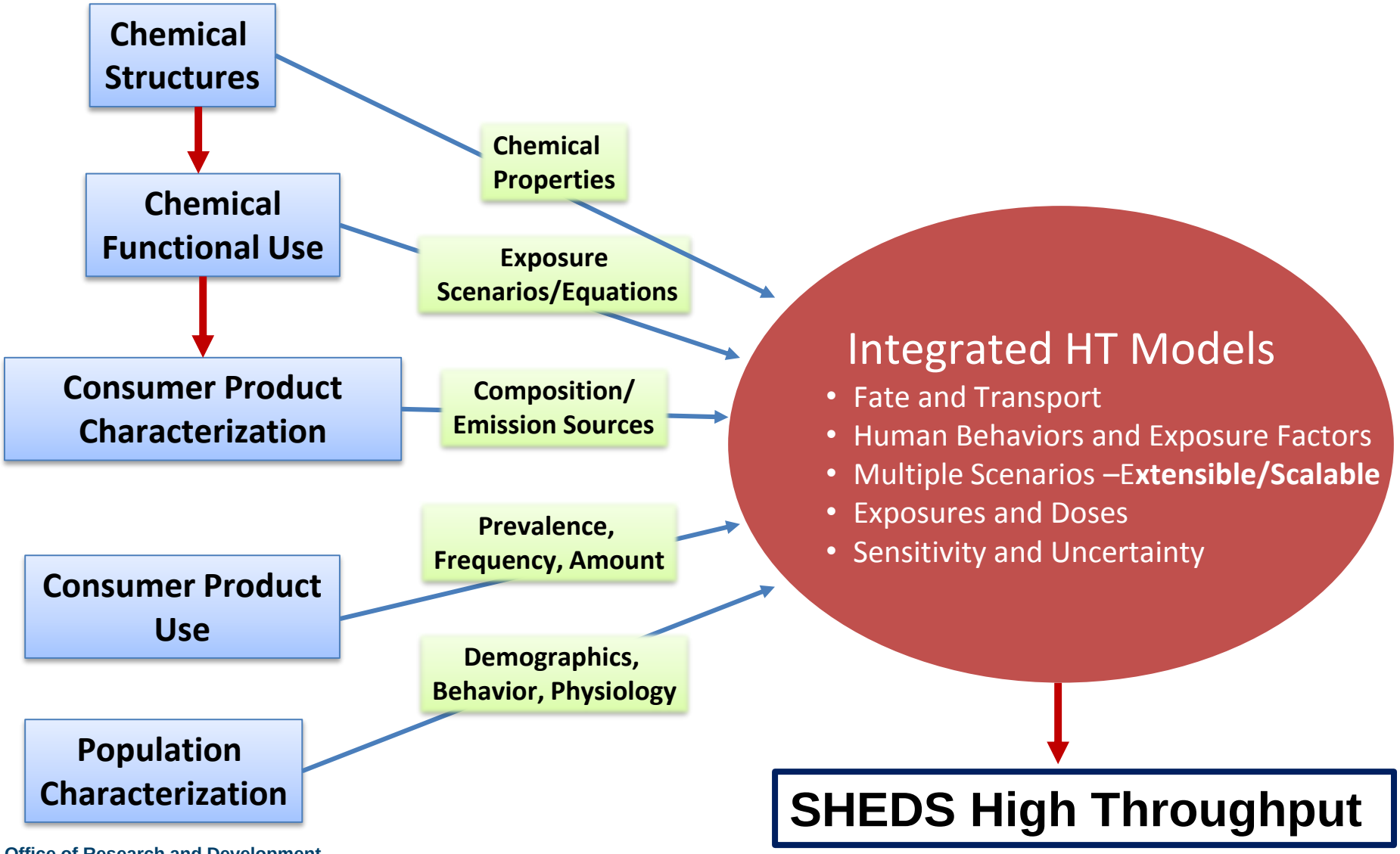
Example Distributions of Estimated Doses



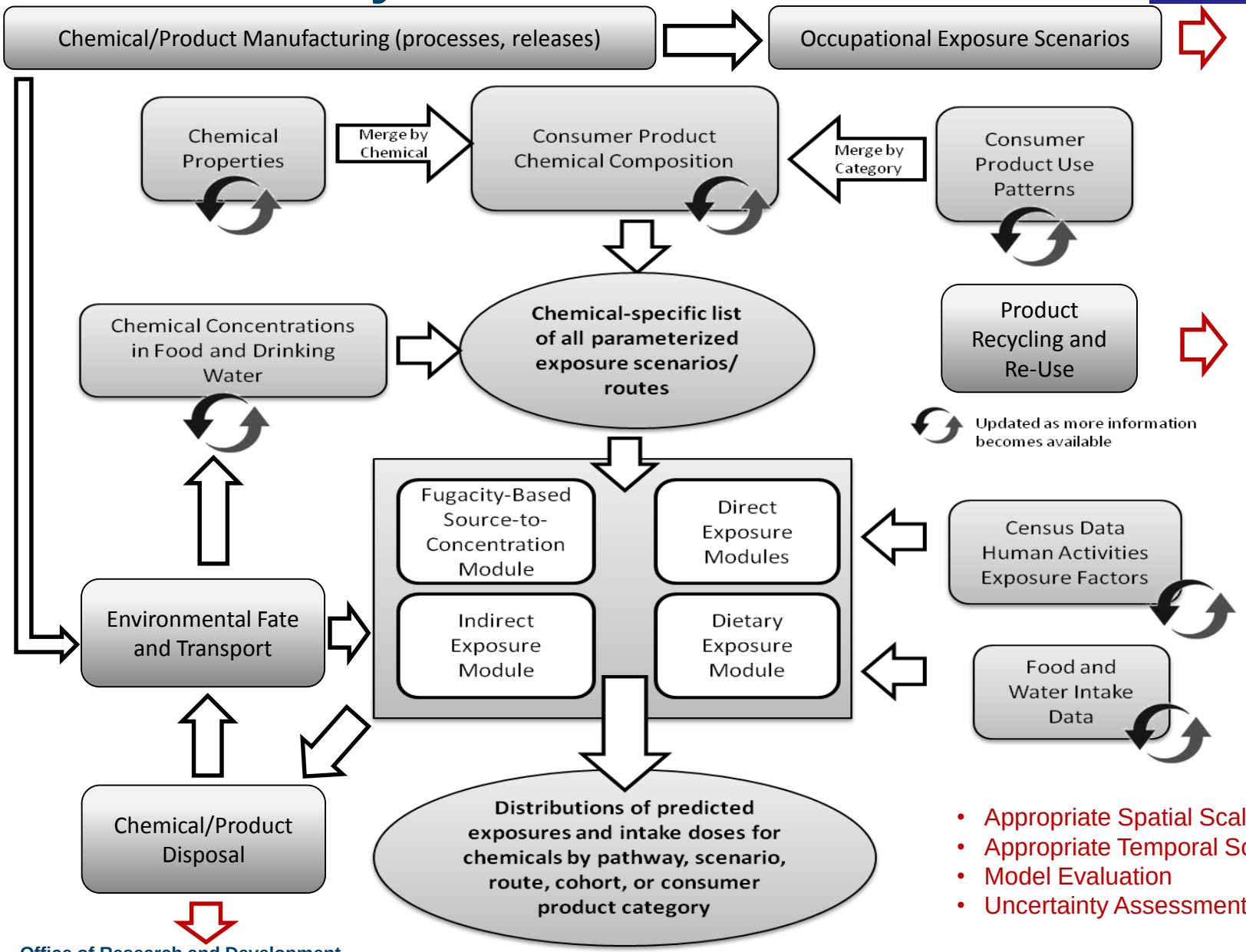
SHEDS Multimedia v4



Computational Models to Rapidly Predict Exposure (Consumer Product Example)



SHEDS Life Cycle – Consumer Products



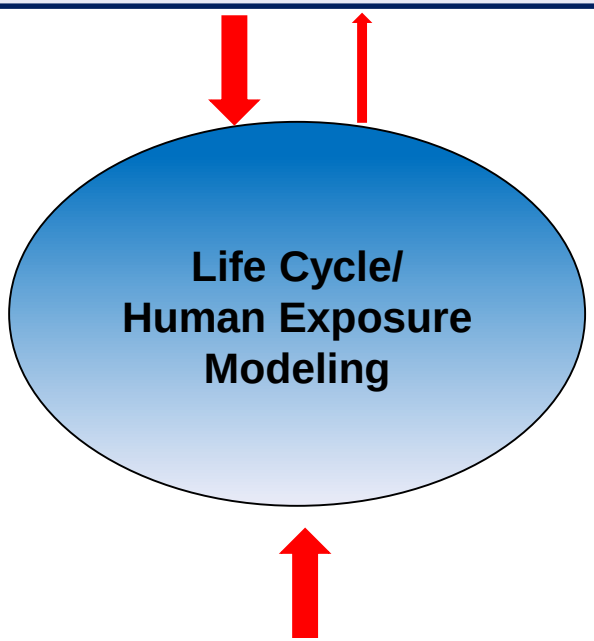
- Appropriate Spatial Scales
- Appropriate Temporal Scales
- Model Evaluation
- Uncertainty Assessment

Integration Within CSS Research Program

CSS Eco Modeling
- LC/HEM tool could/should include eco modeling/risk components

CSS Health Indicator Metrics
- LC/HEM wants to incorporate appropriate health indicators

CSS Rapid Exposure/Dosimetry
- SHEDS-HT
- Product use, fugacity modeling/data
- Dosimetry



Rapid life cycle inventory methods

CSS Sustainable Chemistry
- Chemical information resources
- Alternatives assessment

CSS Emerging Materials
- Engineered nanomaterials life cycle assessment
- Potential out-year case study

CSS AOP Discovery and Development
- ADME module for dose modeling
- Toxicokinetics

Continuing Discussion Points

Development and integration of health effects indicators

Integration of ecological modeling

Identifying potential collaborations (internal and external)