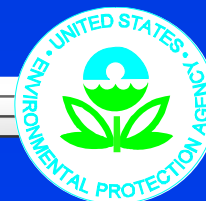


# ***Selected Current and Suggested Ideas on Uses of HPV Challenge Data***

**Nhan Nguyen  
US EPA**

**Characterizing Chemicals in Commerce:  
Using Data on High Production Volume Chemicals  
December 13, 2006  
Austin, Texas**



# Conference Goals

- 1) Educate stakeholders on HPV Challenge Data and other data sources;
- 2) Share experiences about their uses;
- 3) Develop ideas for data accessibility, user-friendliness, and relevancy.



# Presentation Overview

- Overview of Selected OPPT Tools
- Selected Current Uses of HPV Challenge Data
  - Evaluate models / verify model estimates
  - Develop or expand chemical categories and analogues for new chemical assessments.
  - Improve accuracy of current models for risk-screening.
- Selected Possible Uses of HPV Challenge Data
  - Screening Ideas
  - P2 Application – Identification of potential safer substitutes



# OPPT Tools

## EPI Suite

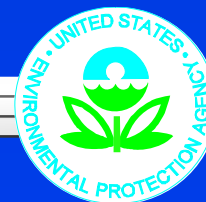
- What is EPI Suite?
  - Estimation Program Interface (EPI) Suite predicts physical and chemical (P/C) and environmental fate properties
  - EPI Suite uses Structure Activity Relationships (SARs) for individual or category chemicals and the chemical structure as only input.
  - Intended for use only in absence of measured values
  - An extensive database of experimental data is included within EPI Suite (>40,000 chemicals)
  - EPI Suite can use experimental data to improve the estimations of the other properties



# OPPT Tools

## ECOSAR

- What is ECOSAR?
  - ECOSAR (Ecological Structure Activity Relationships) is a software program that uses chemical structure to predict toxicity of a chemical to aquatic organisms (SAR)
    - » *Acute and chronic toxicity endpoints*
    - » *Fish, aquatic invertebrates, algae, and others*

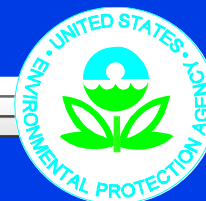


# OPPT Tools

## AIM

### ➤ What is AIM?

- **Analog Identification Methodology (AIM)** is a computational approach for comparing/organizing individual chemicals against sets/databases of chemicals based on structure.
- Can be used to identify closely related analogues and publicly available sources of information where experimental data on the analogues can be obtained.
- Can be used to organize large groupings of chemicals into categories of structural/chemical relevance



# OPPT Tools

## PBT Profiler

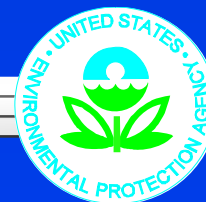
- What is PBT Profiler?
  - The PBT Profiler is a screening-level tool that helps identify potentially **P**ersistent, **B**ioaccumulative, and **T**oxic chemicals using a series of computer estimation methods.
  - PBT Profiler employs methodologies in EPI Suite and ECOSAR.



# OPPT Tools

## ChemSTEER

- What is ChemSTEER?
  - In the absence of monitoring data, the **Chemical Screening Tool for Exposure and Environmental Releases** tool will estimate occupational exposures and environmental releases of chemicals.
  - ChemSTEER estimates are based on industry-specific exposure and release scenarios, models, and submission data.





# OPPT Tools

## E-FAST

### ➤ What is E-FAST?

- The **Exposure and Fate Assessment Screening Tool** provides screening-level estimates of the concentrations of chemicals released to air, surface water, landfills, and from consumer products.
- The software provides estimates on environmental exposures and exposures to consumers and the general public based on generic scenarios, models, and data.



# Current Uses of HPV Data



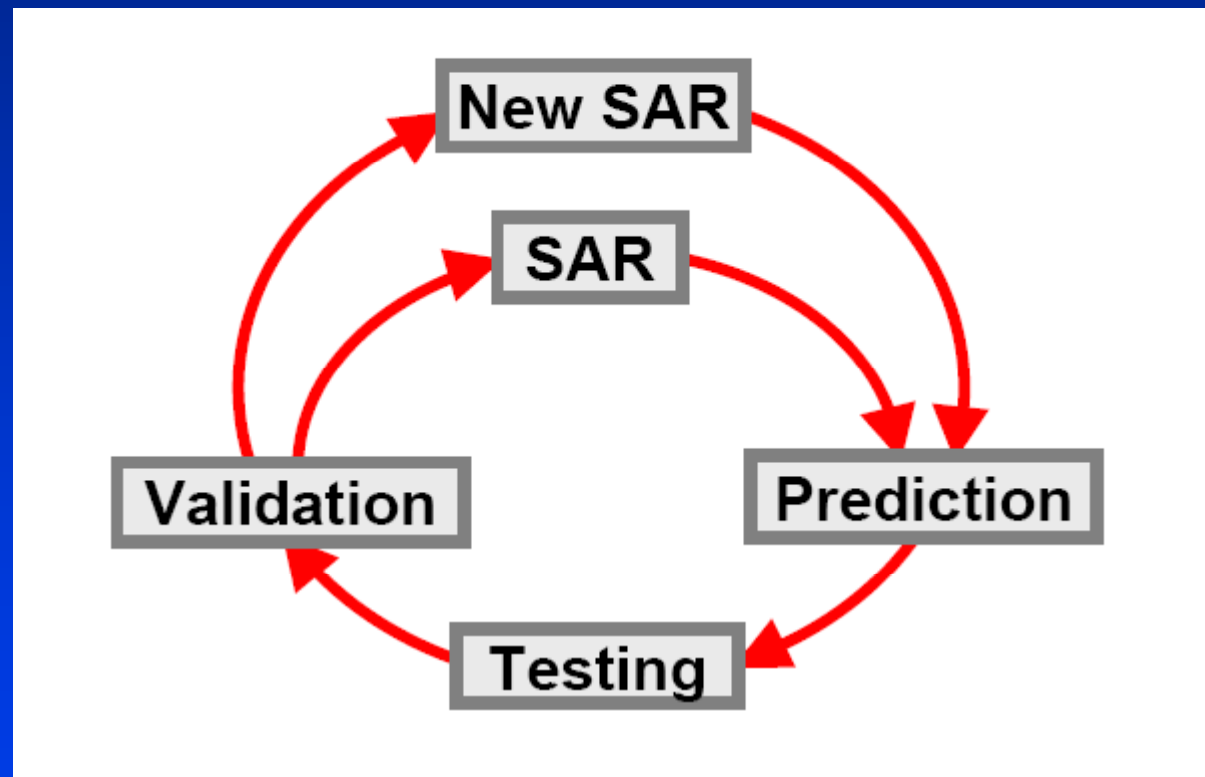
# HPV Data can be used to:

- Evaluate models / verify model estimates:
  - ECOSAR case study – predicted versus measured data
- Expand and develop chemical categories and analogues for new chemical assessments using OPPT tools, such as:
  - AIM
  - PBT Profiler
  - ECOSAR
- Improve accuracy of exposure estimates generated by models, such as:
  - ChemSTEER
  - E-FAST
  - EPI Suite



## *Evaluate model / Verify model estimates*

- HPV data provide testing data that is used to evaluate SARS in ECOSAR and EPI Suite



## *Evaluate model / Verify model estimates*

### ➤ Example

- Case Study (2000). Under the Sustainable Futures Initiative, the predictive capabilities of ECOSAR was compared against measured aqua toxicity data for 38 polymer compounds with SARs model predictions.
- Results. The SARS models were in concordance with measured values 91% of the time.



## Evaluate model / Verify model estimates

### ➤ Example (Continued)

Reliability of SARs When Compared to Experimental Data

Groups and Numbers of Polymer Substances Tested	<i>Daphnia</i> Data	Fish Data	Algae Data	Overall Reliability
Polyester (7)	1 / 1 *	3 / 3	4 / 4	100%
Polyurethane (5)	3 / 3	1 / 1	2 / 2	100%
Acrylates (3)	4 / 6 (4 / 4) **	2 / 2	4 / 5	77% (91%) **
Epoxides (13)	13 / 13	5 / 5	0 / 3	86%
Anhydrides (4)	2 / 2	2 / 2	2 / 2	100%
Melamine (1)	0 / 1			0%
Total (38)	23 / 26 (23 / 24) **	13 / 13	12 / 16	87% (91%) **

\* Numbers in Agreement / Numbers Evaluated.

\*\* Two comparisons were considered to be inconclusive.  
Values in ( ) are excluding inconclusive results.



## *Expand and develop chemical categories and analogues*

- HPV Challenge information can be used to expand chemical categories and provides additional analogues for predicting toxicity of non-HPV chemicals.
- Example: AIM



# Expand and develop chemical categories and analogues

## ➤ Example: AIM

### Experimental Data Sources Indexed

#### On-Line Databases

[TSCATS](#)

[HSDB](#)

[IRIS](#)

#### U.S. Government Documents

[NTP](#)

[ATSDR](#)

[HPV Challenge Program](#)

#### Other Sources

[DSSTox](#)

[RTECS](#)

[IUCLID](#)

[AEGLS](#)

### There are three ways to run AIM

#### 1) Quick Search by SMILES notation

Submit SMILES Notation

#### 2) Draw your compound

Draw your structure



#### 3) CAS Registry number Search


Submit

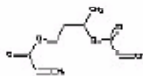
Isodecyl acrylate SMILES Entered

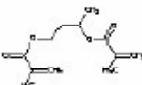


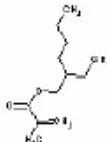



# Expand and develop chemical categories and analogues

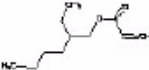
ISODECYL ACRYLATE [CAS No. 1330-61-6]			
<p><u>Analog # 1</u></p> 	Toxicity Data Available for this Compound		
	On-Line Databases	U.S. Government Documents	Other Sources
			<u>RTECS</u>

2-PROPENOIC ACID, 1-METHYL-1,3-PROPANEDIYL ESTER [CAS No. 19485-03-1]			
<p><u>Analog # 4</u></p> 	Toxicity Data Available for this Compound		
	On-Line Databases	U.S. Government Documents	Other Sources
	<u>TSCATS</u>		<u>RTECS</u>

1,3-BUTYLENEDIMETHACRYLATE [CAS No. 1189-08-8]			
<p><u>Analog # 2</u></p> 	Toxicity Data Available for this Compound		
	On-Line Databases	U.S. Government Documents	Other Sources
	<u>TSCATS</u>		<u>RTECS</u>



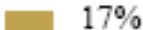

2-ETHYLHEXYL 2-METHYL-2-PROPENOATE [CAS No. 688-84-6]			
<p><u>Analog # 5</u></p> 	Toxicity Data Available for this Compound		
	On-Line Databases	U.S. Government Documents	Other Sources
	<u>TSCATS</u>		<u>RTECS</u>

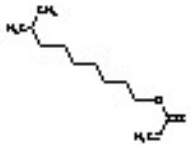
ISODECYL METHACRYLATE [CAS No. 29964-84-9]			
<p><u>Analog # 3</u></p> 	Toxicity Data Available for this Compound		
	On-Line Databases	U.S. Government Documents	Other Sources
	<u>TSCATS</u>		<u>RTECS</u> <u>IUCLID</u>

[CAS No. 1322-13-0]			
<p><u>Analog # 6</u></p> 	Toxicity Data Available for this Compound		
	On-Line Databases	U.S. Government Documents	Other Sources
			<u>RTECS</u>

# Expand and develop chemical categories and analogues

## ➤ Example (PBT Profiler)

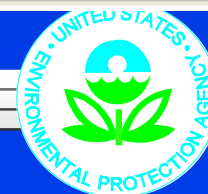
<u>Persistence</u>			<u>Bioaccumulation</u>	<u>Toxicity</u>
1330616 Isodecyl acrylate				
PBT Profiler Estimate = <b>PBT</b>				
<u>Media</u>	<u>Half-Life</u> (days)	<u>Percent in</u> <u>Each Medium</u>	<u>BCE</u>	<u>Fish ChV</u> (mg/l)
Water	15	 13%	160	0.005
Soil	30	 68%		
Sediment	140	 17%		
Air	0.67	 2%		



**P2 Considerations and more information**

Based on its structure, this chemical may belong to the acrylates/methacrylates category.

▶ Members of this category may have potential human health concerns. [More information and category definitions.](#)



## *Expand and develop chemical categories and analogues*

- HPV Challenge Program provides measured data that can be used to develop additional estimation methods for categories of chemicals  
→ expand predictive capabilities of models
- Example SAR
  - Acrylates:  $\log \text{LC50(mM/L)} = -1.46 - 0.18 \log K_{ow}$
  - In the ECOSAR method (in EPI Suite), aquatic toxicity can be calculated for chemicals or classes of chemicals using regression equations.



## *Improve accuracy of models for risk-screening*

- P/C properties (HPV data) is used by ChemSTEER to estimate environmental releases and occupational exposures
- P/C + and environmental fate properties (HPV data) + Results from ChemSTEER are used by E-FAST to estimate environmental and general population exposures



## Improve accuracy of models for risk-screening

### ➤ Example #1

- P/C properties (e.g. vapor pressure, molecular weight) are inputs in vapor release models such as the EPA/OAQPS AP-42 Loading Model in ChemSTEER to determine a vapor generation rate.

$$G \text{ (g/s)} = f \times \text{MW} \times (3785.4 \times V_c) \times r \times X \times (\text{VP} / 760) / (3600 \times T \times R)$$

G = vapor generation rate

X = vapor pressure correction factor

VP = vapor pressure of the pure chemical

T = temperature

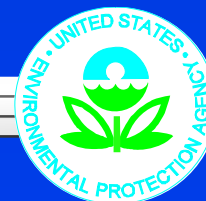
R = universal gas constant

f = saturation factor

MW = molecular weight

V<sub>c</sub> = container volume

r = fill rate



## Improve accuracy of models for risk-screening

### ➤ Example #1 (cont'd)

- The vapor generation rate is then used by the EPA/OPPT Mass Balance Model to estimate occupational inhalation exposures in ChemSTEER.

$$I = 170,000 \times T \times \underline{G} \times b \times h \times 1/(V_m \times Q \times k)$$

I = inhalation potential dose rate    T = temperature

G = vapor generation rate            b = inhalation rate

h = exposure duration

V<sub>m</sub> = molar volume of gas

Q = ventilation rate

k = mixing factor



## *Improve accuracy of models for risk-screening*

- Example #1 (cont'd)
  - The fugitive air release calculated from ChemSTEER may also be used in E-FAST (e.g., Air Dispersion Model) to determine the air concentrations → general population and environmental exposures



## *Improve accuracy of models for risk-screening*

### ➤ Example #2

- P/C properties (e.g. Kow, water solubility) are inputs to the EPI Suite STP Fugacity Model to determine a wastewater treatment removal efficiency.
- The removal efficiency is also used in the Probabilistic Dilution Model (PDM) in E-FAST to predict downstream chemical concentrations from a facility's industrial releases.





## *Improve accuracy of models for risk-screening*

### ➤ Other examples

- $K_{ow}$  is also used to calculate the bioconcentration factor (BCFWIN Model in EPI Suite), which is useful in E-FAST to determine exposures from water releases.
- P/C properties (e.g. VP, MW) are also used in E-FAST models such as the Consumer Exposure Model.



# Selected Ideas for Other Uses of HPV Data



# *Priority Setting/Risk Screening*

## *Using HPV hazard information to prioritize chemicals*

- As recommended by the National Pollution Prevention and Toxics Advisory Committee, EPA is implementing a screening process using hazard information from the HPV Challenge Program
- Details on screening process discussed in Session 4A “EPA Prioritization Process and Development of Hazard Profiles for HPV Challenge Program Data”



# Priority Setting/Risk Screening

## Combining HPV with Inventory Update Reporting (IUR)

### ➤ What is IUR?

- The IUR regulation requires manufacturers and importers of certain chemical substances included on the TSCA Chemical Substance Inventory to report site and manufacturing information for chemicals manufactured (including imported) in amounts of 25,000 pounds or greater at a single site.
- Additional information on domestic processing and use must be reported for chemicals manufactured in amounts of 300,000 pounds or more at a single site.



# Priority Setting/Risk Screening

## Combining HPV with Inventory Update Reporting (IUR)

- Acutely toxic chemicals (based on HPV data) could be used with IUR data to identify industries and or sites with high occupational risks and hence potential targets for regulatory limits (e.g. future PELs)
- HPV data can be used with IUR data to identify potential concern chemicals with consumer use, childrens use, or high potentially exposed # of workers.



# Priority Setting/Risk Screening

## Combining HPV with Toxic Releases Inventory (TRI)

### ➤ What is TRI?

- The Toxics Release Inventory (TRI) is a publicly available EPA database that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities.
- Only facilities that fall under a certain SIC code, have a minimum of 10 workers, and meet the activity threshold for reporting must report.



# Priority Setting/Risk Screening

## Combining HPV with Toxic Releases Inventory (TRI)

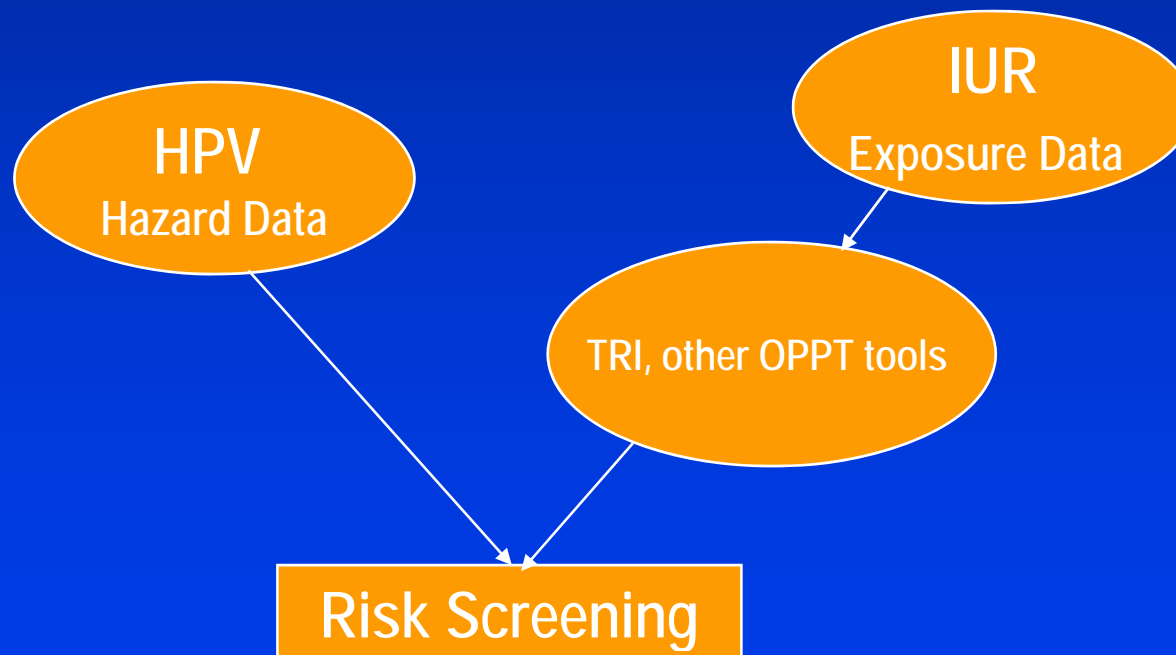
- Chemicals with high aquatic toxicity (HPV data) could be used with site-specific release information from TRI to identify locations with potentially high concentrations and hence exposures to chemicals of environmental concern.



# Priority Setting/Risk Screening

## Combining HPV with TRI and IUR Information

- HPV data provides hazard information.
- IUR data provides exposure related information that may be used in combination with other models and data to:
  - Determine potential screening-level occupational/general population risk.
  - Determine potential screening-level environmental risk.





## Identification of potential safer substitutes

- Evaluate alternative chemicals and technologies through a stakeholder process
- **Objective** - Drive innovation toward environmentally safer substitutes by developing approaches that inform substitute choices
- **Examples**
  - Furniture Flame Retardancy Partnership
    - » *Evaluated Alternatives to Pentabromodiphenyl ether, a flame retardant previously used in furniture foam.*
  - Flame Retardants in Printed Circuit Boards Partnership
    - » *High volume flame retardant application - ~300 million pounds/year tetrabromobisphenol A*
  - Safer Detergents Stewardship Initiative
    - » *Encourage the use of safer surfactants*
- **Attributes considered:**
  - Performance, cost/benefits
  - P/C and fate properties, toxicity (e.g. HPV data)
  - Other information (e.g. IUR data)



# Summary

- HPV data contribute to the improvement of estimation models or results of OPPT tools, such as:
  - EPI Suite
  - ECOSAR
  - PBT Profiler
  - AIM
  - ChemSTEER
  - E-FAST
- HPV data may be useful for risk screening purposes and for identifying/comparing alternative chemicals and processes
  - IUR
  - TRI
  - Safer Substitutes



**Suggestions or Questions?**

