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ITRC Contaminants of Emerging Concern Identification Framework

Contaminants of Emerging Concern Identification Framework, cec-1.itrcweb.org

- CLU-IN training page at https://www.clu-in.org/conf/itrc/CEC/ Under "Webinar Slides & References", you can download the slides

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Contaminants of Emerging Concern Identification Framework
(CEC 2023)

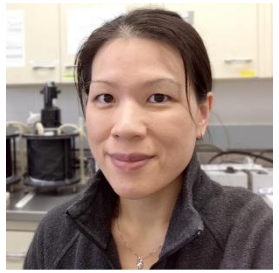
Sponsored by: Interstate Technology and Regulatory Council (www.itrcweb.org)

Meet the ITRC Trainers

Kim Nimmer
City of Raleigh, North Carolina
Kim.Nimmer@raleighnc.gov

José Zambrana, Jr.
US Environmental Protection Agency, Office of Research and Development
Zambrana.Jose@USEPA.gov

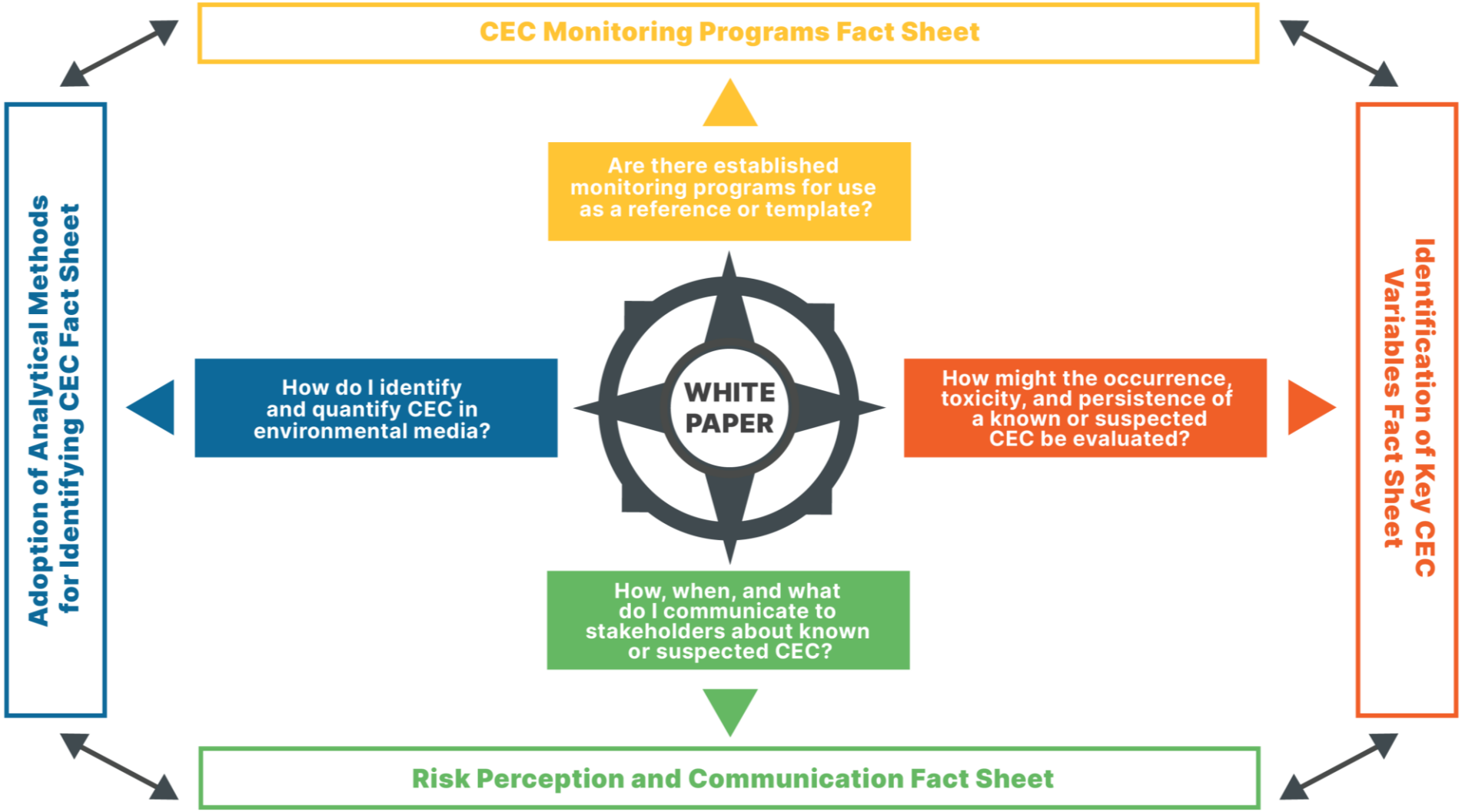
Meaghan Cibarich
Wisconsin DNR
MeaghanE.Cibarich@wisconsin.gov



Helen Buse
US Environmental Protection Agency, Office of Research and Development
Buse.Helen@epa.gov

Carol Stein
Emeritus Member
csteinpe101@gmail.com

CEC Identification Framework

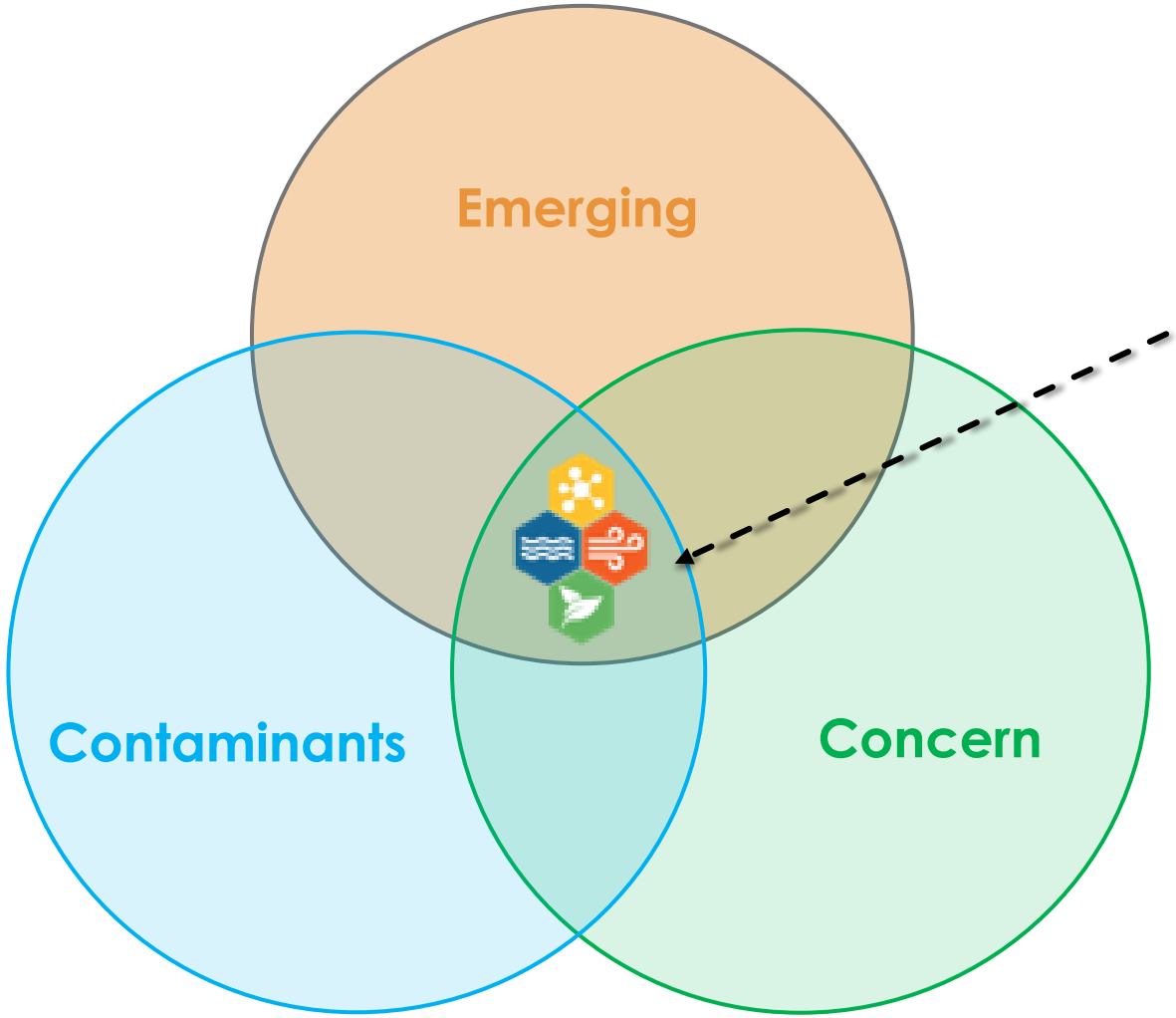


https://cec-1.itrcweb.org/

ITRC's CEC Definition

CEC are substances and microorganisms including physical, chemical, biological, or radiological materials known or anticipated in the environment, that may pose newly identified risks to human health or the environment.

Scope of CEC



CEC are

Substances and microorganisms known or anticipated in the environment...

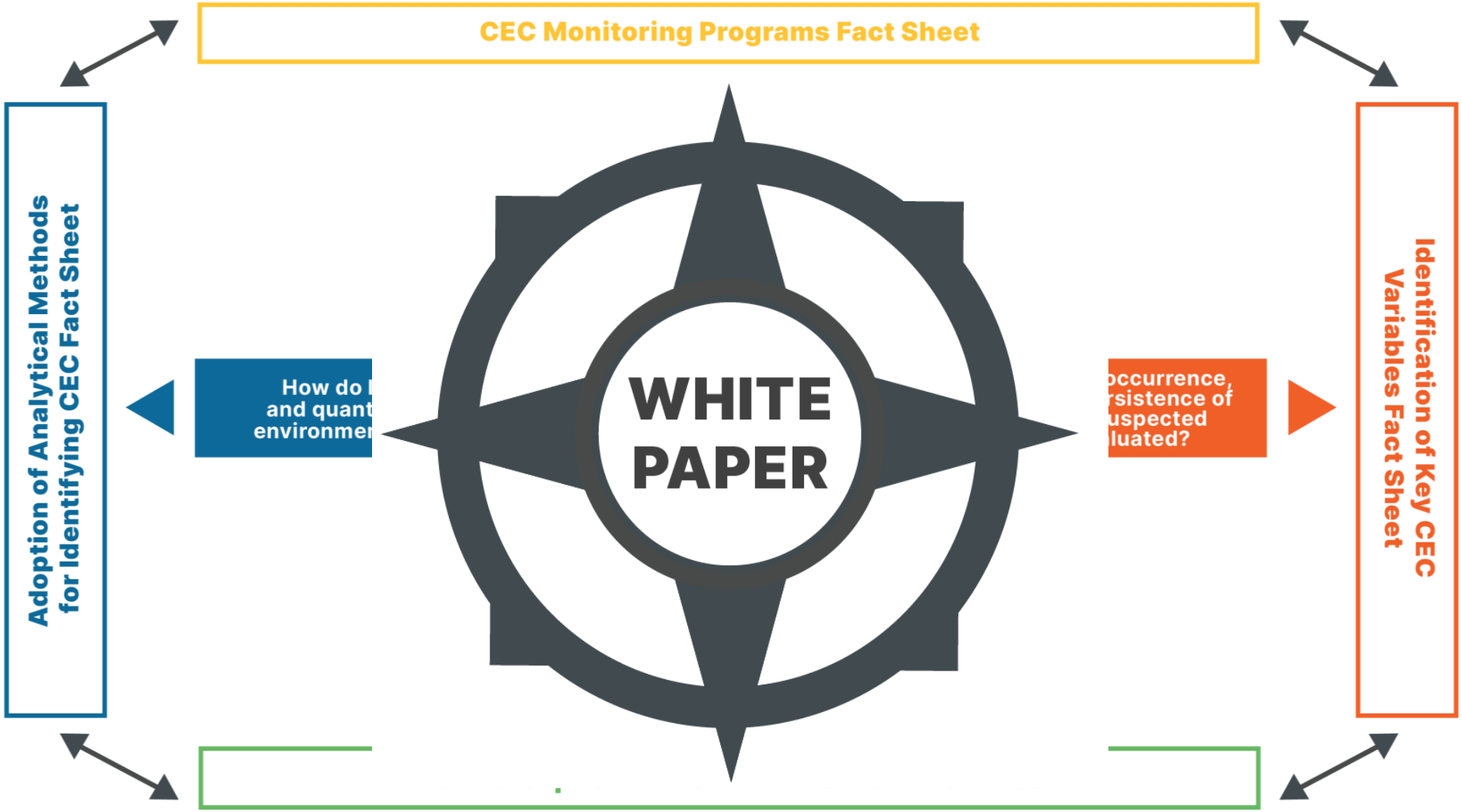
may pose newly identified

risks to human health or the environment

CEC Definition

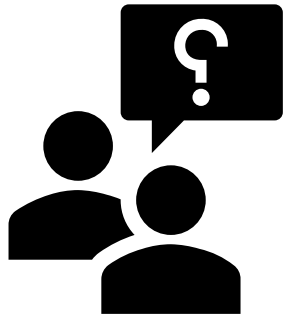
- Bipartisan Infrastructure Law [BIL] – 2022
  - This definition aligns with the language taken from the BIL that provides guidance for obtaining allocated funding to address CEC
  - Implementation of the Clean Water and Drinking Water State Revolving Fund Provisions
- The current focus of this training is primarily on chemical contaminants
- ITRC Biologicals CEC Team (2025 publication)

CEC Identification Framework



WHY is a CEC Framework Needed?

CEC Challenges



- New and/or insufficient data
- Insufficient experience
- Not all states have CEC monitoring programs
- How to evaluate and prioritize CEC
- How to identify a CEC when no known validated laboratory method exists
- Communication of risk

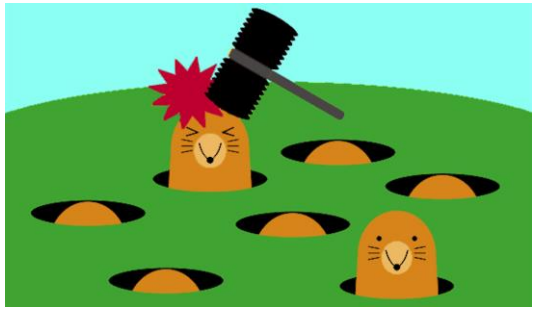
More WHY…

Provide regulatory agencies (and other stakeholders) with a framework to identify and prioritize CEC

- scientifically informed, peer reviewed, and systematic
- provides flexibility for unique situations, environments, and resource availability.

Scope of the Problem

- There are over 80,000 chemicals in commerce (TSCA)
- This doesn't include radiologicals, biologicals, microplastics…
- The absence of data on potential exposure, toxicity, and fate and transport of CEC prevents informed decision making to protect health and the environment.



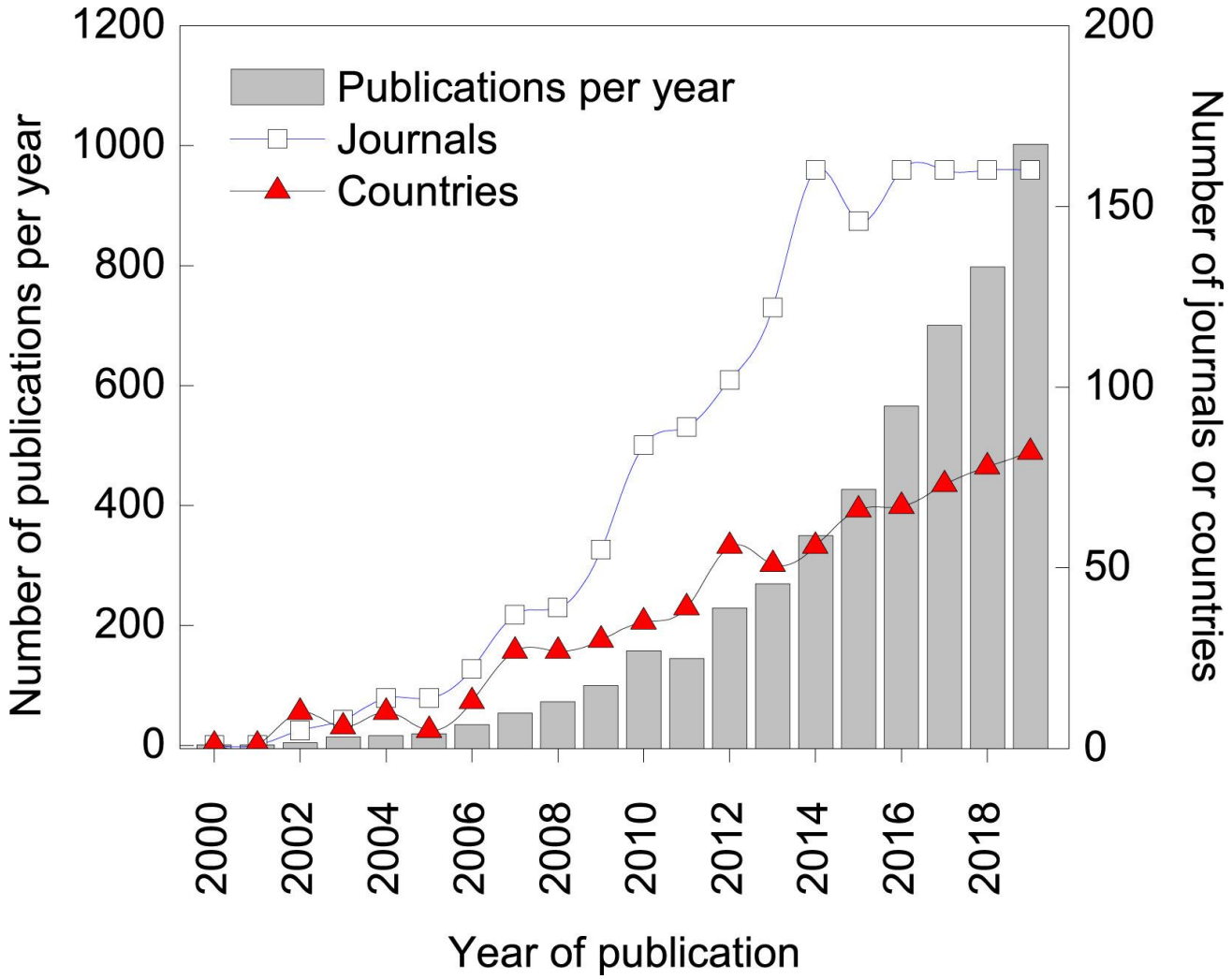
How can states address CEC considering the challenges on data sufficiency and resource availability?

Intended Audience for ITRC CEC Products

State environmental or health regulatory agencies

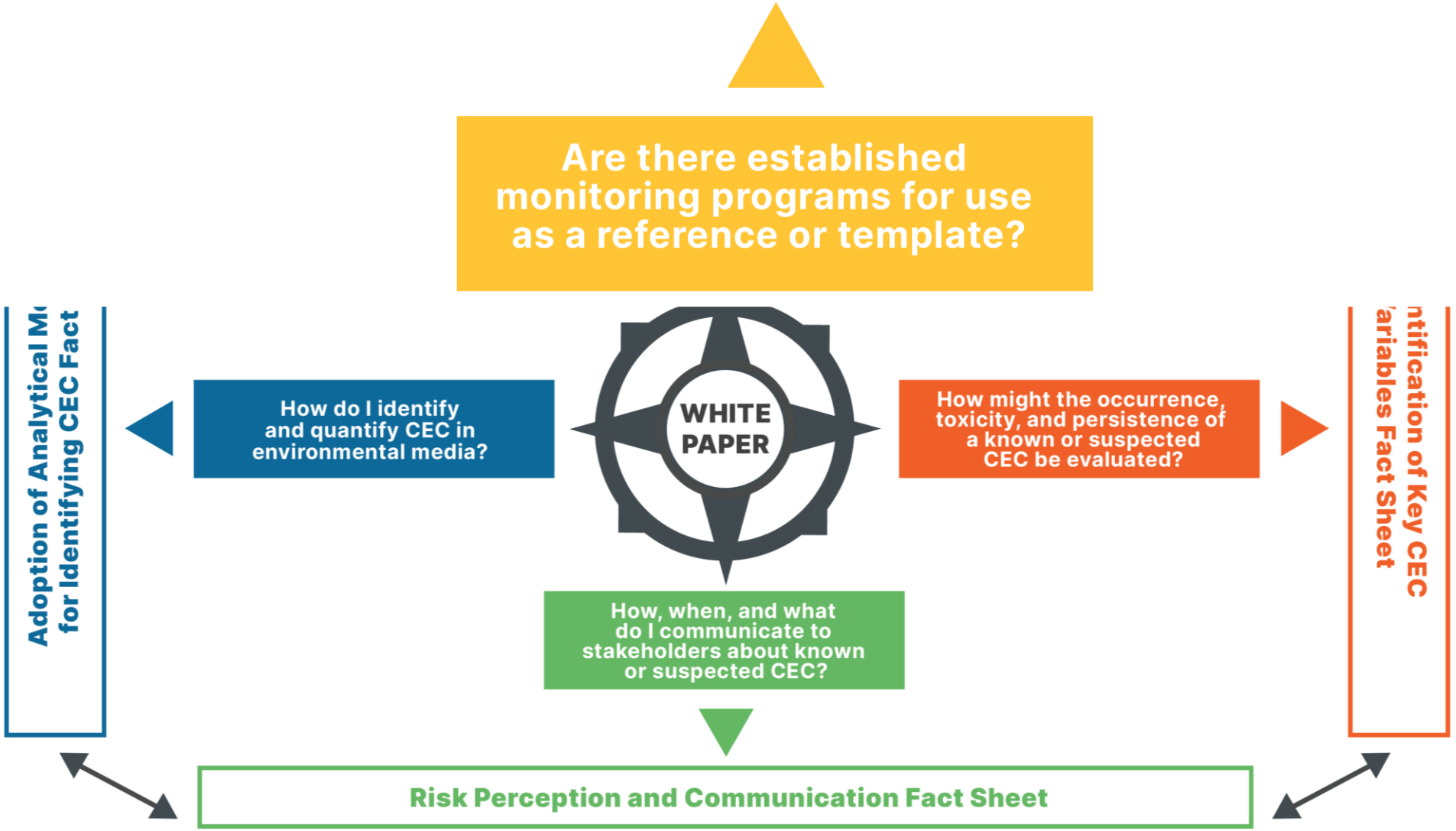
Programs tasked with monitoring and identifying potentially harmful substances in the environment

Research on CEC



Increasing research on CEC. Source: Ramirez-Malule et al., 2020

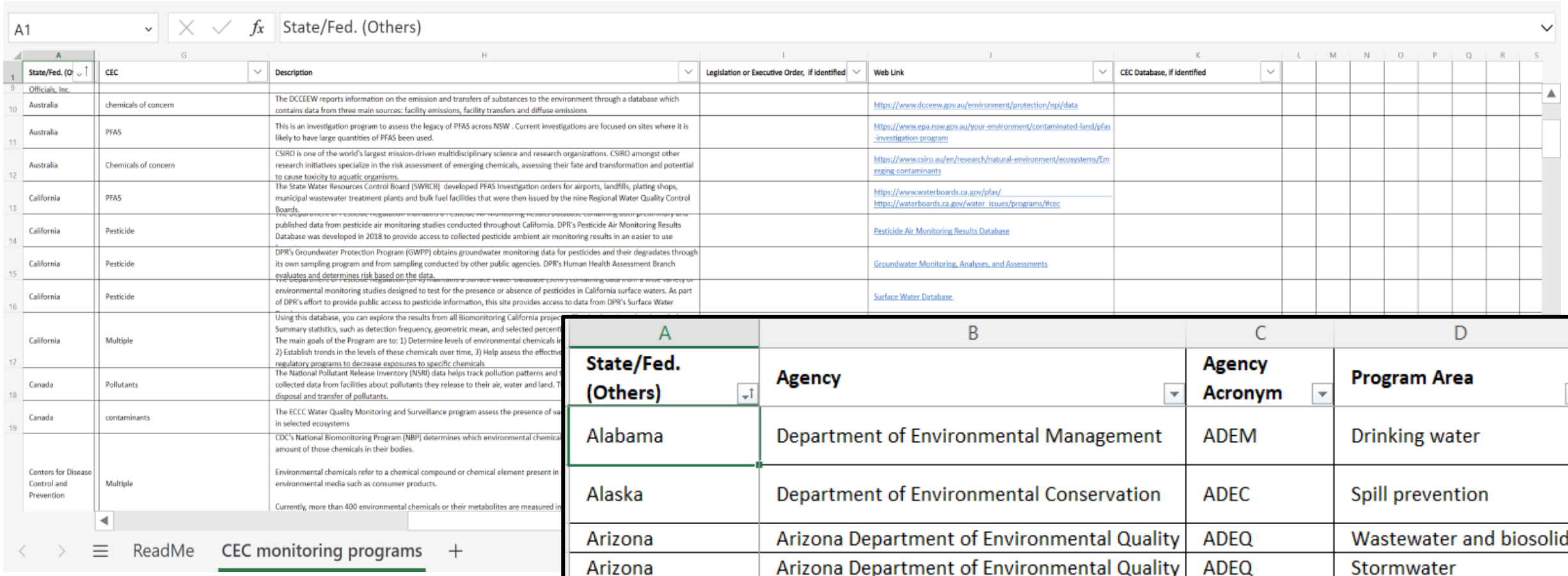
CEC Monitoring Programs Fact Sheet



CEC Monitoring Program Fact Sheet

Provides material to assist states and other stakeholders in formulating their own CEC programs.

CEC Monitoring Programs Table



A1 | State/Fed. (Others)

State/Fed. (Others)	CEC	Description	Legislation or Executive Order, if identified	Web Link	CEC Database, if identified
Australia	chemicals of concern	The DCCEEW reports information on the emission and transfers of substances to the environment through a database which contains data from three main sources: facility emissions, facility transfers and diffuse emissions		https://www.dcceew.gov.au/environment/protection/npi/data	
Australia	PFAS	This is an investigation program to assess the legacy of PFAS across NSW . Current investigations are focused on sites where it is likely to have large quantities of PFAS been used.		https://www.epa.nsw.gov.au/your-environment/contaminated-land/pfas-investigation-program	
Australia	Chemicals of concern	CSIRO is one of the world's largest mission-driven multidisciplinary science and research organizations. CSIRO amongst other research initiatives specialize in the risk assessment of emerging chemicals, assessing their fate and transformation and potential to cause toxicity to aquatic organisms.		https://www.csiro.au/en/research/natural-environment/ecosystems/Emerging-contaminants	
California	PFAS	The State Water Resources Control Board (SWRCB) developed PFAS Investigation orders for airports, landfills, plating shops, municipal wastewater treatment plants and bulk fuel facilities that were then issued by the nine Regional Water Quality Control Boards.		https://www.waterboards.ca.gov/pfas/ https://waterboards.ca.gov/water_issues/programs/#cec	
California	Pesticide	published data from pesticide air monitoring studies conducted throughout California. DPR's Pesticide Air Monitoring Results Database was developed in 2018 to provide access to collected pesticide ambient air monitoring results in an easier to use		Pesticide Air Monitoring Results Database	
California	Pesticide	DPR's Groundwater Protection Program (GWPP) obtains groundwater monitoring data for pesticides and their degradates through its own sampling program and from sampling conducted by other public agencies. DPR's Human Health Assessment Branch evaluates and determines risk based on the data.		Groundwater Monitoring, Analyses, and Assessments	
California	Pesticide	environmental monitoring studies designed to test for the presence or absence of pesticides in California surface waters. As part of DPR's effort to provide public access to pesticide information, this site provides access to data from DPR's Surface Water		Surface Water Database	
California	Multiple	Using this database, you can explore the results from all Biomonitoring California projec Summary statistics, such as detection frequency, geometric mean, and selected percent The main goals of the Program are to: 1) Determine levels of environmental chemicals i 2) Establish trends in the levels of these chemicals over time, 3) Help assess the effectiv regulatory programs to decrease exposures to specific chemicals			
Canada	Pollutants	The National Pollutant Release Inventory (NSRI) data helps track pollution patterns and collected data from facilities about pollutants they release to their air, water and land. T disposal and transfer of pollutants.			
Canada	contaminants	The ECCC Water Quality Monitoring and Surveillance program assess the presence of va in selected ecosystems			
Centers for Disease Control and Prevention	Multiple	CDC's National Biomonitoring Program (NBP) determines which environmental chemica amount of those chemicals in their bodies. Environmental chemicals refer to a chemical compound or chemical element present in environmental media such as consumer products. Currently, more than 400 environmental chemicals or their metabolites are measured in			

ReadMe | CEC monitoring programs

A	B	C	D
State/Fed. (Others)	Agency	Agency Acronym	Program Area
Alabama	Department of Environmental Management	ADEM	Drinking water
Alaska	Department of Environmental Conservation	ADEC	Spill prevention
Arizona	Arizona Department of Environmental Quality	ADEQ	Wastewater and biosolids
Arizona	Arizona Department of Environmental Quality	ADEQ	Stormwater
Arizona	Arizona Department of Environmental Quality	ADEQ	Environmental Protection

[Demo Video! https://youtu.be/T8ap6Qjxisk](https://youtu.be/T8ap6Qjxisk)

CEC Monitoring Programs Table

A	State/Fed Agency/Other	Name of the State/Federal Agency, or Association
B	Agency	Full Agency name
C	Agency Acronym	Acronym commonly used for the Agency
D	Program Area (categories)	Air Quality, Biomonitoring, Drinking water, Ecology, Environmental Protection, Groundwater, Hazardous substances, Health, Land protection, Multiple (see description), Other (see description), RCRA, Remediation, Solid and hazardous wastes, Spill prevention, Stormwater, Surface water, Water resources, Water quality, Wastewater and biosolids, Waste management
E	Focus Area	Additional details of program area if applicable
F	Monitoring Media	Air, Biological tissues, Biosolids, Drinking water, Groundwater, Human Health, Landfill leachate, Multiple (see description), Other (see description), Solid waste, Soil, Stormwater, Surface water, Wastewater
G	CEC	Description of which contaminants of emerging concern addressed in the monitoring program
H	Description	Short description of monitoring program and additional details if needed
I	Legislation or Executive Order	Reference to legislation if applicable
J	Web Link	Hyper link to home of the monitoring program
K	CEC Database	Hyper link to specific database if applicable for CEC

Environmental Programs Covered in the Fact Sheet

- Air Quality
- Biomonitoring
- Drinking water
- Ecology
- Environmental Protection
- Groundwater
- Hazardous substances
- Health
- Land Protection
- RCRA, Remediation, Solid and hazardous wastes
- Spill prevention
- Stormwater
- Surface water
- Water resources
- Water quality
- Wastewater and biosolids
- Waste management

Environmental Programs Not Covered in the Fact Sheet

- Only public education such as "What are PFAS?"
- Programs that monitor products (i.e., personal care products, packaging)
- Detailed sampling methods, analytical methods, and compliance limits
- Programs specific to one site
- Programs that describe just physical and chemical properties
- Programs that list toxicity values or derivations of toxicity values
- Programs that regulate and monitor parent compounds that have the potential to degrade or break down to a CEC

Limitations and Barriers the Fact Sheet

CEC selection criteria for establishing CEC monitoring programs are not universally applied due to variations in:

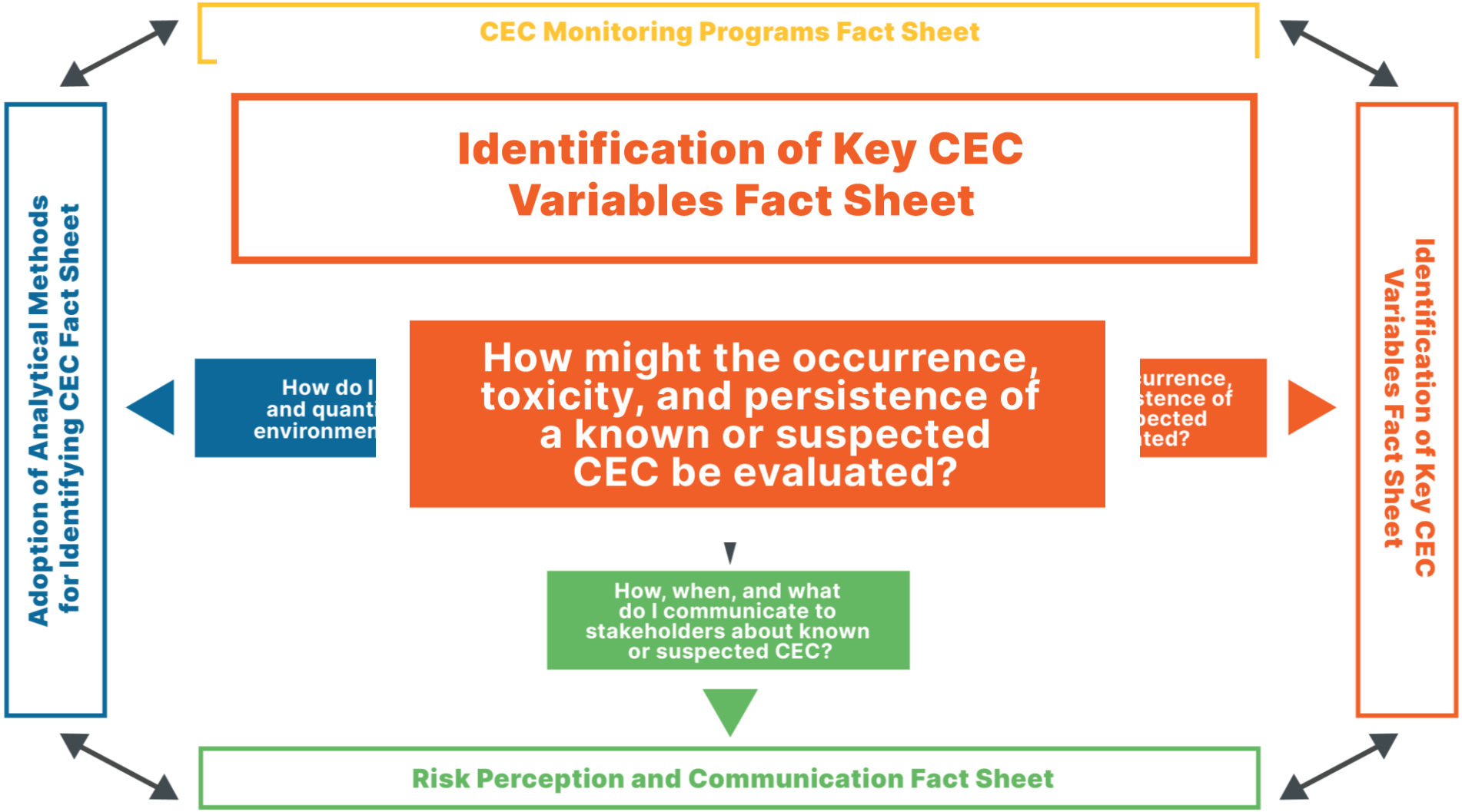
- Regulation
- Resource availability
- Key CEC variables

(see ITRC Identification of Key Variables Fact Sheet)

Key Takeaways About Monitoring Programs

- Tool now available to learn how different organizations monitor CECs
- Increased CEC monitoring data available for formulating your own CEC monitoring program
- Drinking water data normally more available
- High priority CECs (e.g., PFAS) and monitoring media are more likely leading into development of CEC monitoring programs

CEC Identification Framework



https://cec-1.itrcweb.org/identification-of-key-cec-variables-fact-sheet/

Key CEC Variables Fact Sheet Overview

- Logical Flowchart for CEC evaluation using the risk paradigm
- Resources for identifying information on key variables that inform CEC evaluation: toxicity, exposure, fate and transport
- Questions to consider when evaluating data sufficiency
- Tools to prioritize and interpret CEC data

Why Evaluate Key Variables?

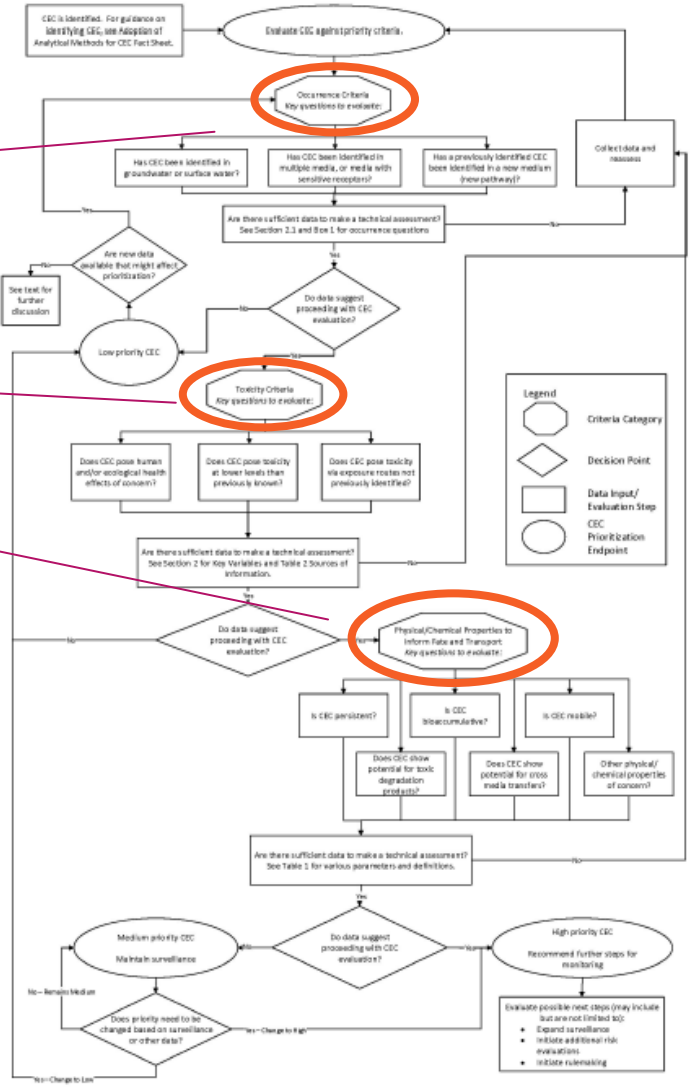
- **Contaminant** (we focus here on chemicals): 1000s of chemicals released to the environment – how to address when public and environmental concerns arise?

- **Emerging**: Often new information on newly identified risks coupled with uncertainty

- **Concern**: Observed direct deleterious effects (human or ecological endpoints) and public concern

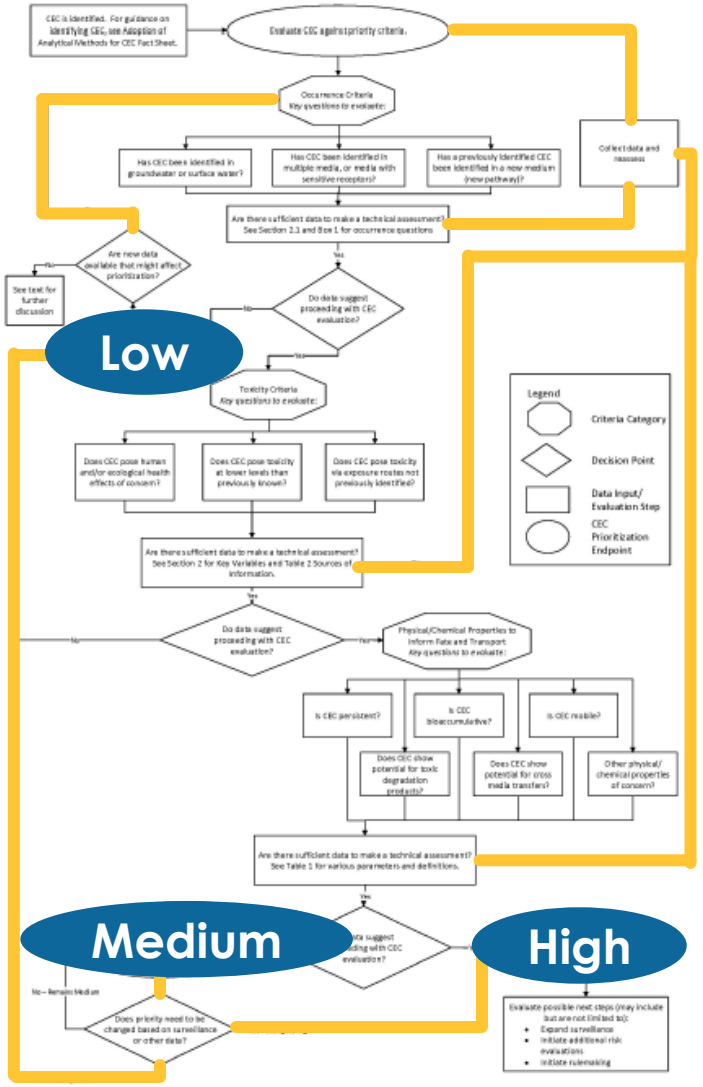
Using Key Variables – Flowchart to Prioritize CEC

- Three Criteria are evaluated
  - Exposure/Occurrence
  - Toxicity
  - Fate and Transport/Chemical Behavior
- Other Considerations:
  - Sufficient data? Data suggest concern?
  - Degradation products, cross media concerns?
- Low, medium, high priority



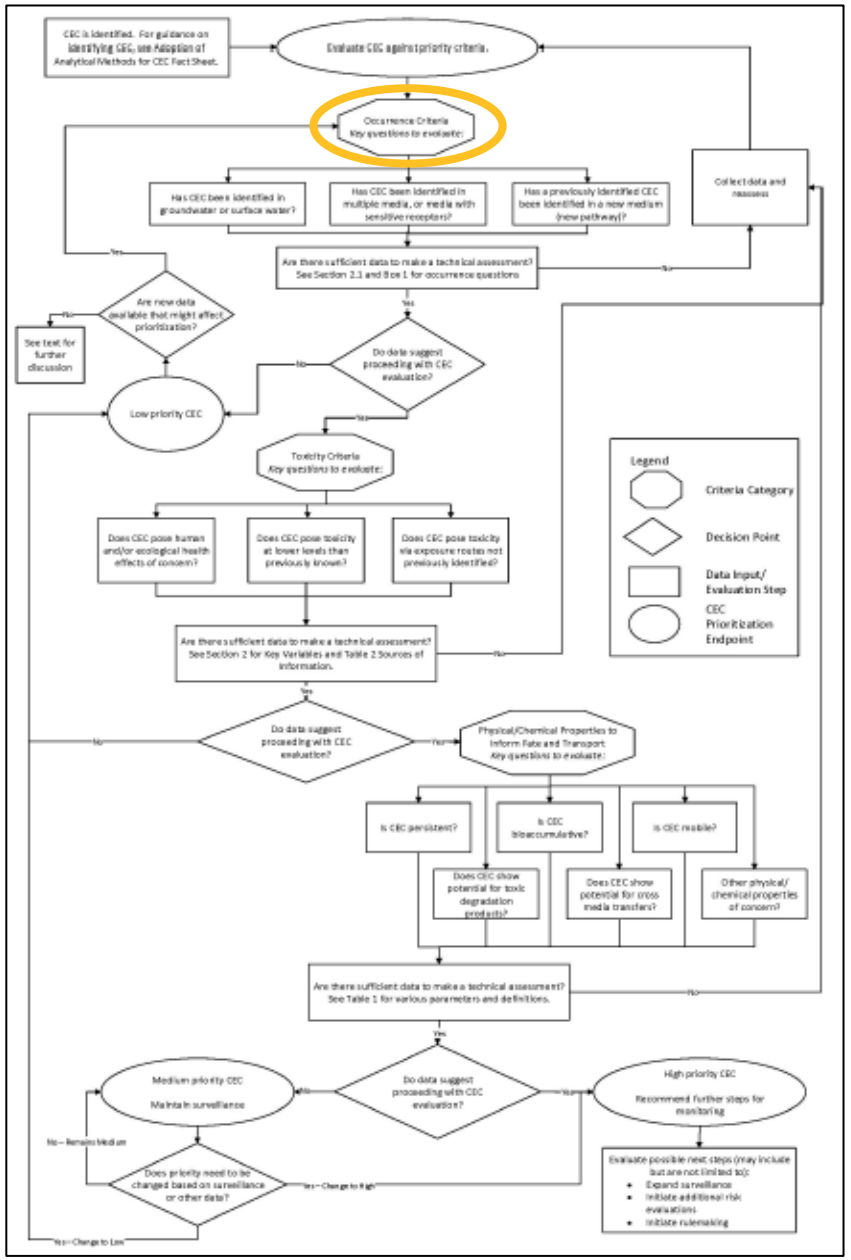
CEC Prioritization Summary

	LOW PRIORITY CEC	MEDIUM PRIORITY CEC	HIGH PRIORITY CEC
Summary of current data	no significant concern	additional information needed for further prioritization	widespread or significant concern
Monitoring Follow Up	no monitoring at this time	continued monitoring	expanded monitoring
Additional Steps	watch for new information	seek out new information that may inform a need for risk characterization	additional risk characterization and potential rulemaking



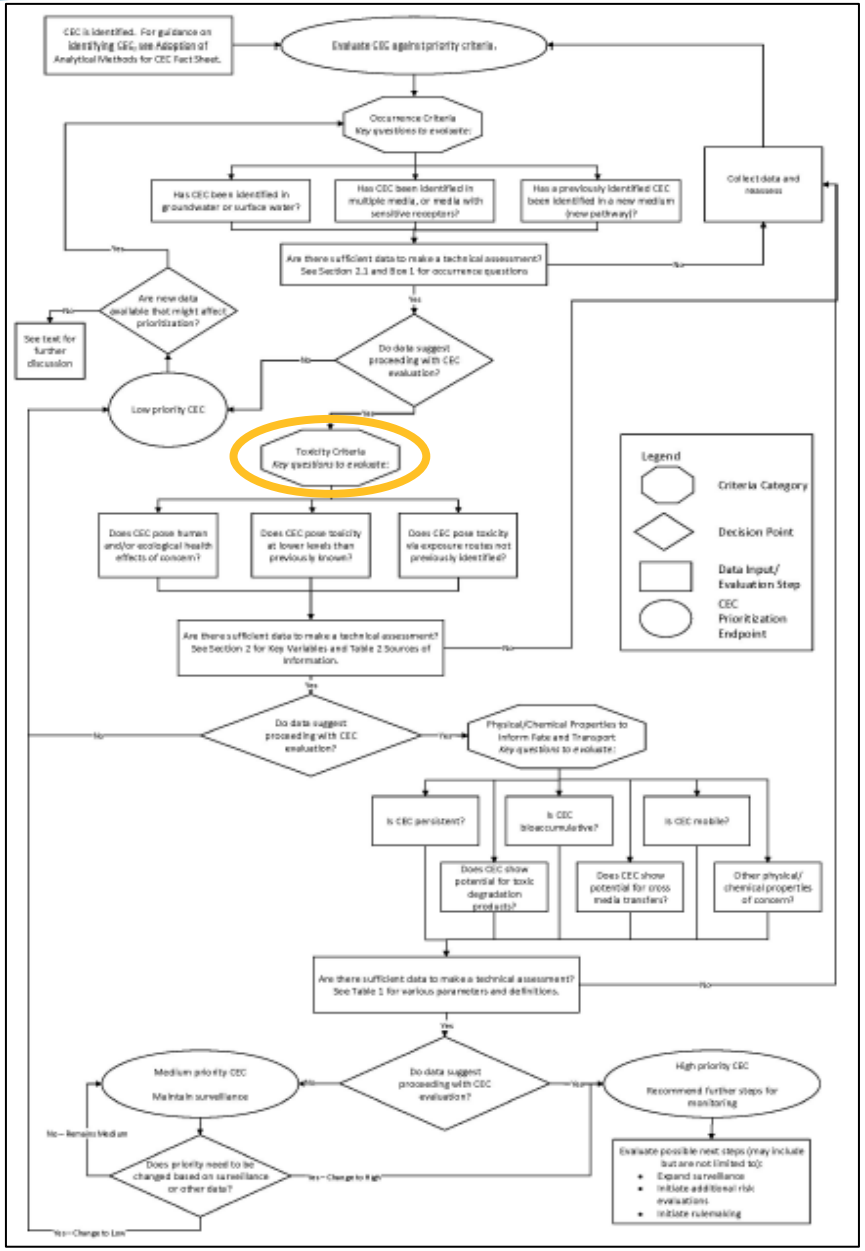
CEC Occurrence – Things to Consider

- Has CEC been identified in groundwater or surface water?
- Has CEC been identified in multiple media (e.g., air) or media with sensitive receptors?
  - Soil – depending on land use, residential, children
  - Consumer products
  - Fisheries (e.g., bioaccumulative effects might outweigh low or non-detect levels in water)
- Has a previously identified CEC been identified in a new medium (new pathway)?



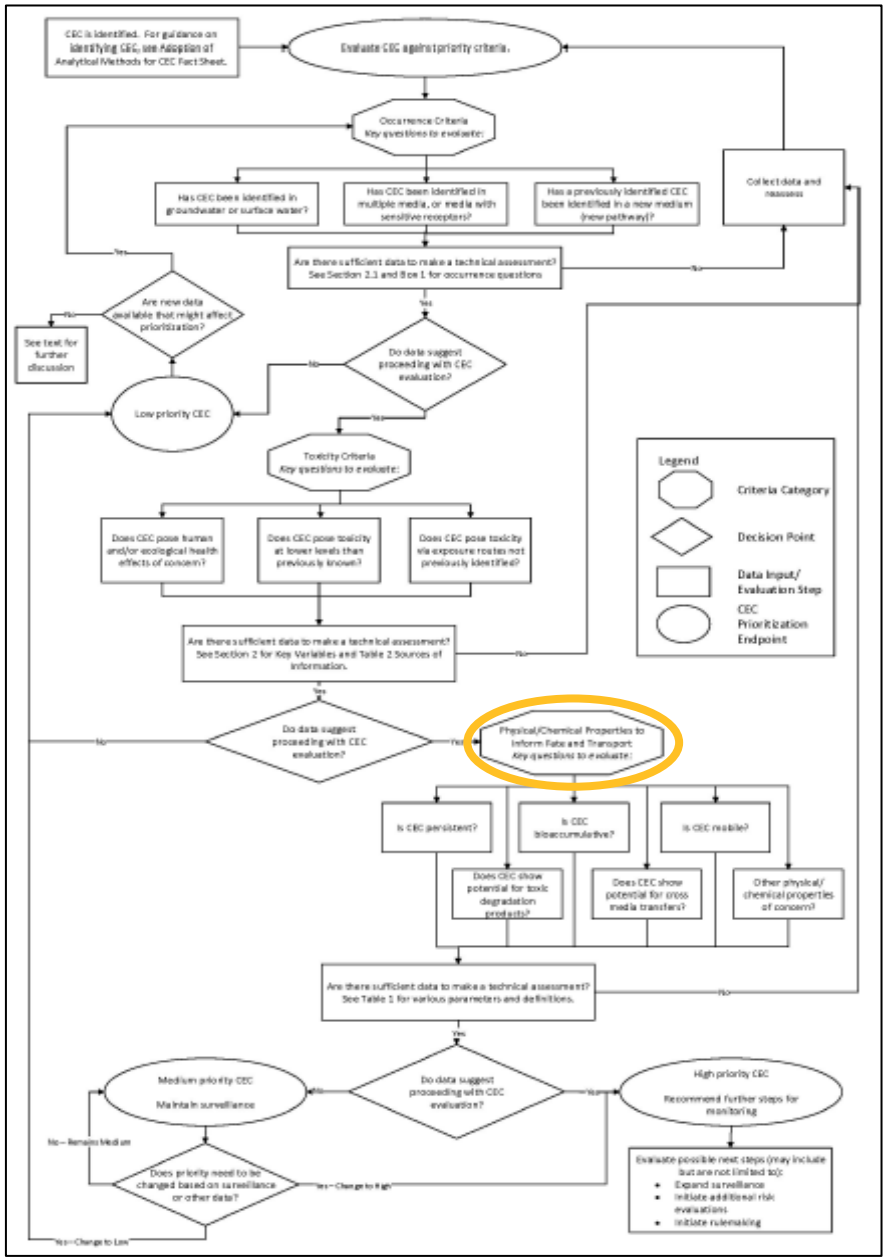
CEC Toxicity – Things to Consider

- Human health-based and/or ecological health effects
- CEC considerations:
  - Sometimes info on chemical characteristics only
  - Toxicity data may be limited, especially for new exposure routes
  - May need to develop or estimate toxicity values
  - Acknowledge data sources, assumptions, and uncertainties



CEC Physical-Chemical Properties – Things to Consider

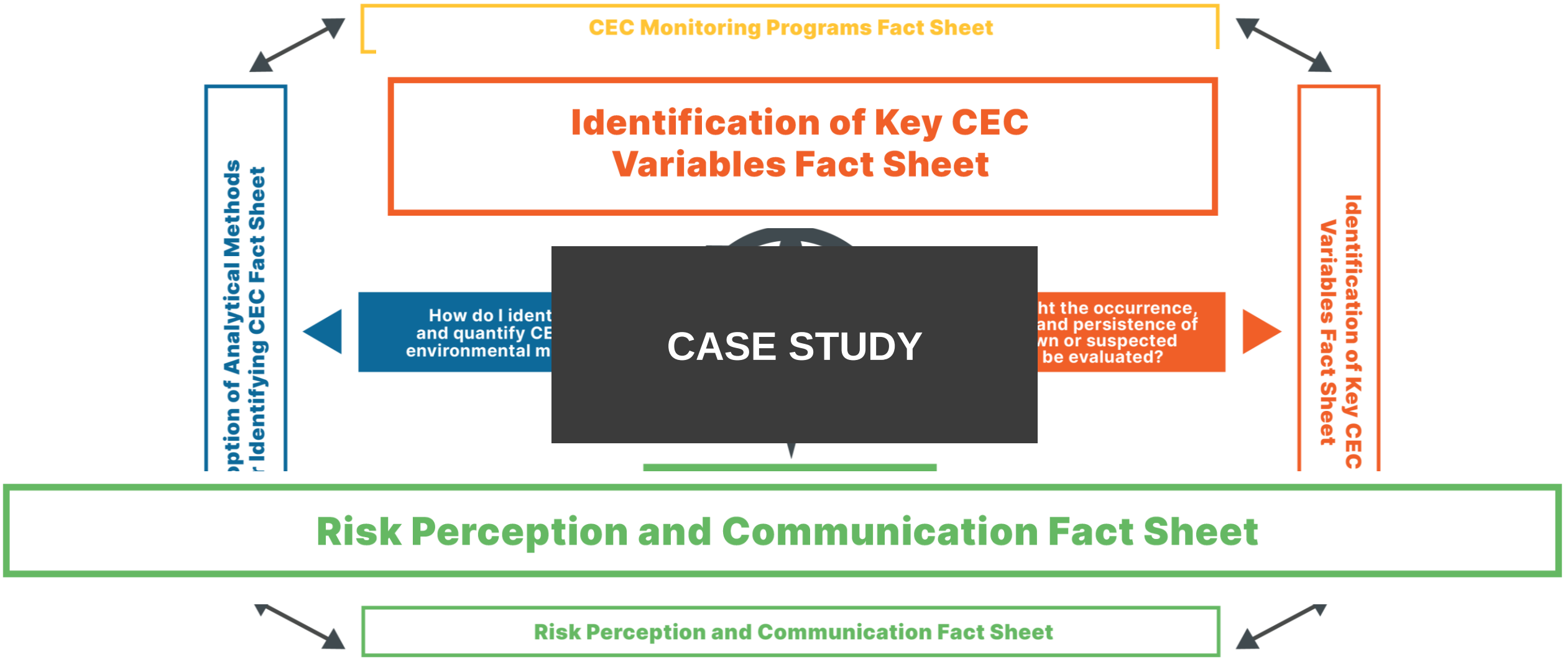
- Inform fate and transport, chemical behavior
- CEC considerations:
  - Does the CEC remain in the environment?
  - In what media? Does it cross media?
  - Does the CEC bioaccumulate?
  - Does it have toxic degradation products?
  - Does it have unique characteristics that affect transport (e.g., foam, amphiphilic)



Summary

- Flowchart for considering key variables to inform prioritizing CEC – low, medium, or high
- Key questions to consider on occurrence, toxicology, and physical-chemical properties that inform fate and transport and chemical behavior
- Resources to inform:
  - Toxicity
  - Fate and Transport
- Key questions for evaluating data sufficiency
- Resources to inform interpreting information on variables
- Case study

CEC Identification Framework



Case Study Scenario

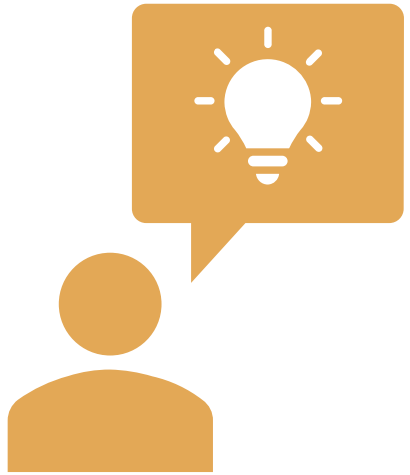
Chemical Name: chloro-α,α,α-trifluorotoluene
CASRN: 98-56-6
Chemical Formula: $C_7H_4ClF_3$
Molecular Weight: 180.56

- The potential CEC was initially detected (first as a TIC and then confirmed with a standard):
  - in the wastewater at an industrial property
  - In a property well used as a drinking water source at the site
- Not listed in any federal or state list of chemicals monitored or analyzed in environmental media.
- Part of a chemical mixture used as a solvent substitute for xylene.
- Follow up testing in wastewater and drinking water samples with QC controls confirmed presence.

Poll Question

What additional information would you seek about this situation?

A. Open ended short answer!



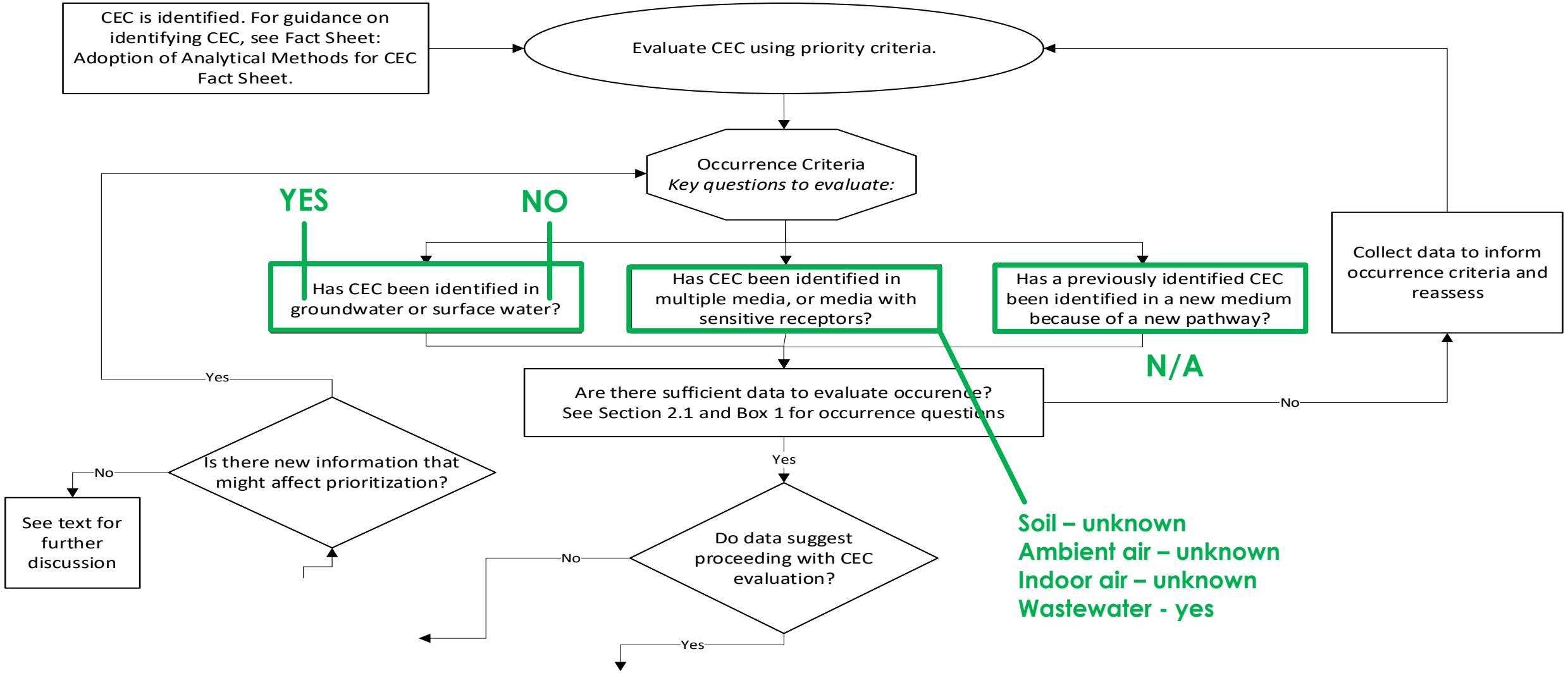
What information is needed to evaluate occurrence?

- Company confirms CEC is in waste stream used as an intermediate in pesticide production
- Workers are drinking water provided by the drinking water well

- Unknowns:
  - The extent of contamination onsite and offsite including soil and ambient air concentrations
  - Volatilization from groundwater to indoor air (potential CEC is solvent used in some caulks, paints and coatings)

- European Chemical Agency reports this chemical is used in (for example):
  - consumer products such as coating products, inks and toners;
  - as an intermediate step in manufacturing of another substance

CEC Occurrence – Information Summary



CEC Occurrence – Evaluation

Consider data sufficiency – Based on your program requirements:

- If "no" then need to collect data to inform occurrence criteria and reassess

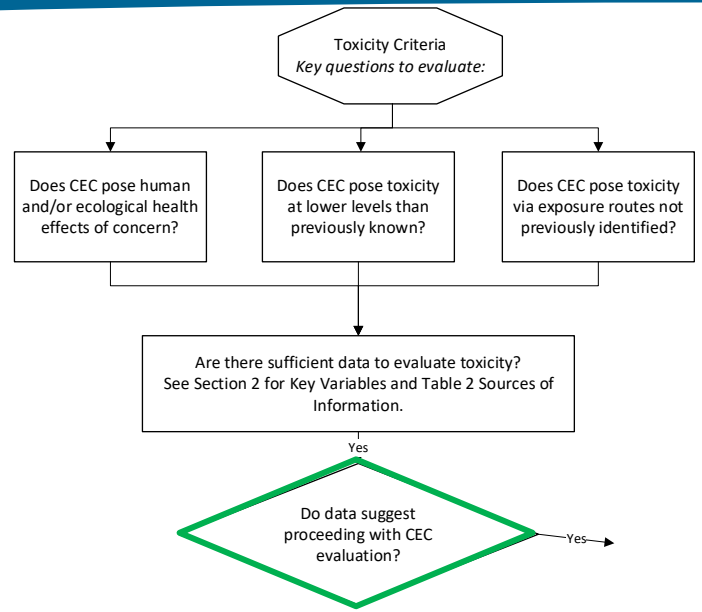
- If "yes", then data can suggest:
  - low priority CEC (e.g., limited exposure/occurrence), or
  - concern sufficient to continue with CEC evaluation

For this case study, occurrence data appears sufficient and indicative of a need to continue with the evaluation

CEC Toxicity – What is Needed?

CalEPA:

- Exposure can occur by passing from mother to baby during pregnancy
- Exposure through inhalation and skin contact
- Likely human carcinogen



ECHA Hazard Classification & Labelling:

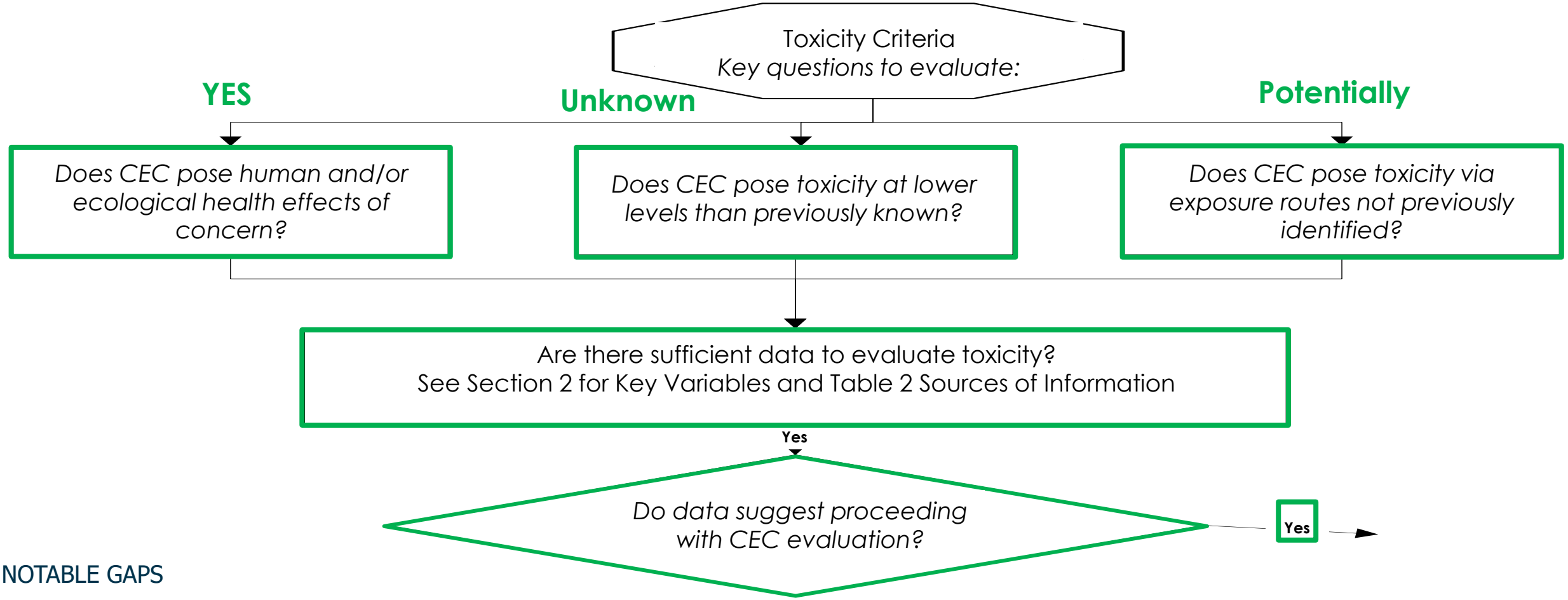
- Suspected of causing cancer
- Suspected of damaging fertility or the unborn child
- Causes serious eye irritation, and may cause an allergic skin reaction or skin irritation

ECHA REACH

- Toxic to aquatic life with long lasting effects; hazard to terrestrial organisms

Chronic Reference Dose (RfD - oral)	Cancer Slope Factor (for inhalation)	Chronic Reference Concentration (RfC - inhalation)	Inhalation Unit Risk Factor (IURF)
$3x10^{-3}$ mg/kg-day (PPRTV 2007)	**$3.0x10^{-2}$ (mg/kg-day)$^{-1}$** (CalEPA 2020)	**$3.0x10^{-1}$ mg/m^3** (PPRTV 2007)	**$8.6x10^{-6}$ (µg/m^3)$^{-1}$** (CalEPA 2020)

CEC Toxicity – Information Summary

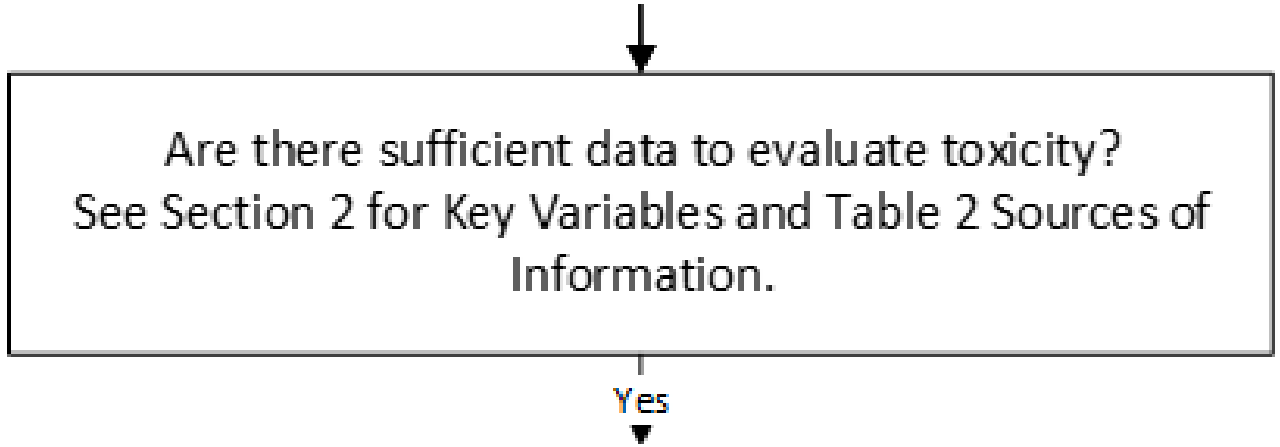


NOTABLE GAPS

- Some noncancer endpoints (e.g., skin irritation, reproductive-developmental effects)
- Further characterization of site soil and ambient air
- Extrapolating from inhalation to oral toxicity value
- Data on additional ecological impact studies on fish and other aquatic species would be helpful

CEC Toxicity – Evaluation

- Consider data sufficiency based on your program requirements
- If "no" then need to collect data to inform toxicity criteria and reassess
- If "yes", then data can suggest continuing with CEC evaluation

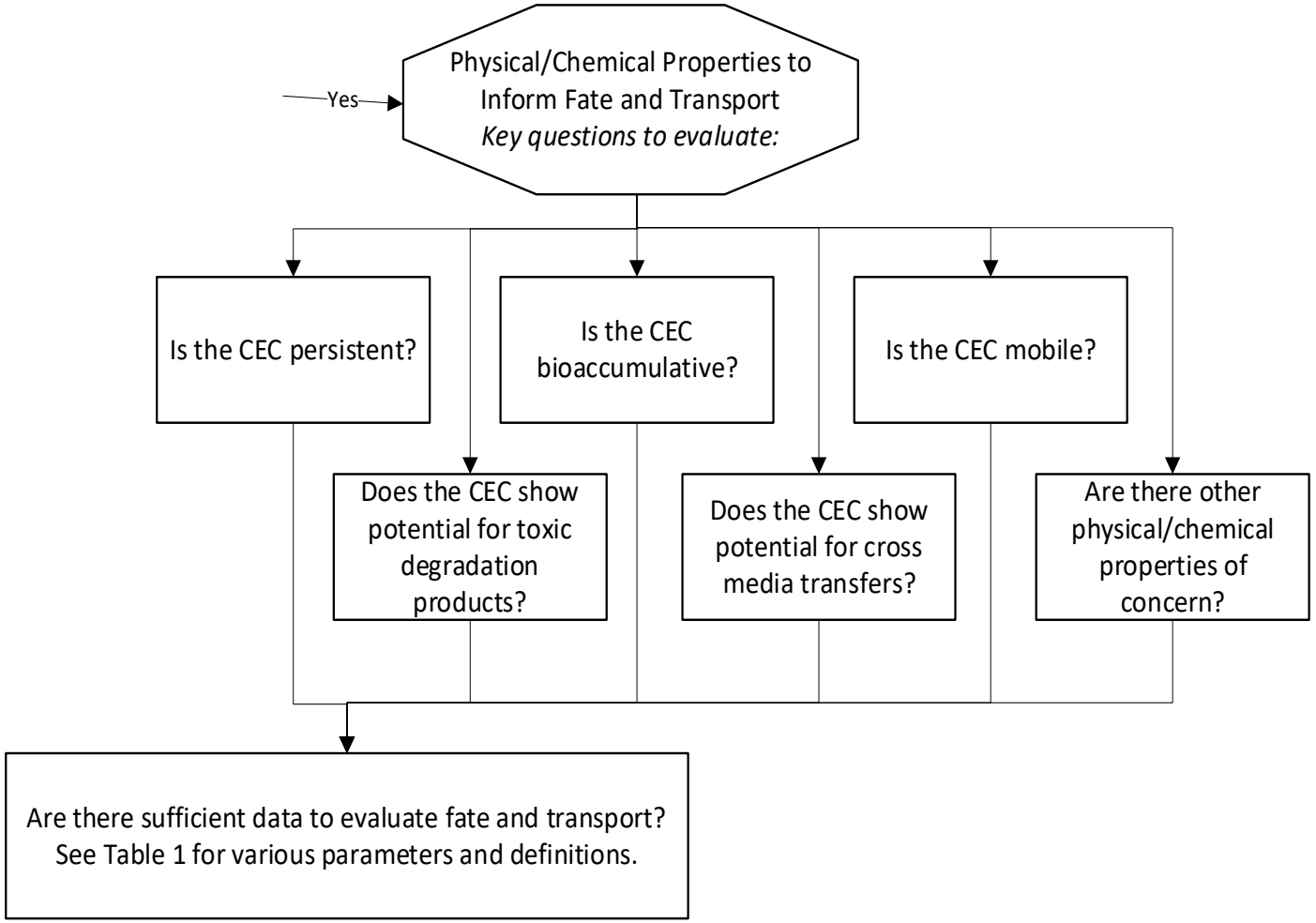


- Preliminary risk characterization is possible: detection of potential CEC levels in groundwater to be evaluated against a cancer-based drinking water screening level or criterion

For this case study, toxicity data appears sufficient and indicative enough of a need to continue with the evaluation

CEC Physical-chemical Properties – Things to Consider

chloro-a,a,a-trifluorotoluene	
Molar mass	180.55 g/mol
Appearance	colorless liquid
Odor	aromatic
Density	1.33 g/mL at 25°C
Melting point	138.5 C
Boiling point	7.6 mm Hg at 25°C
Solubility in water	29 mg/L at 25°C
Log octanol/water partition coefficient	3.60 at 25°C (estimated)



There are some information gaps that need to be filled.

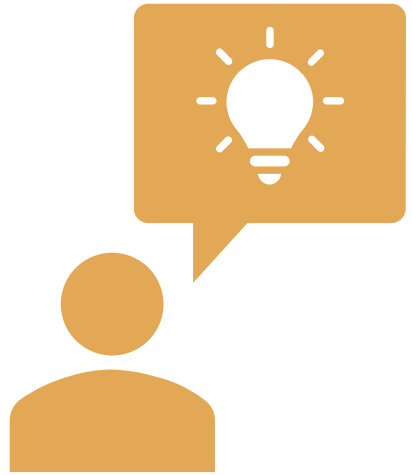
Data are sufficient from exposure and toxicity to suggest continuing the evaluation.

Professional judgement is needed.

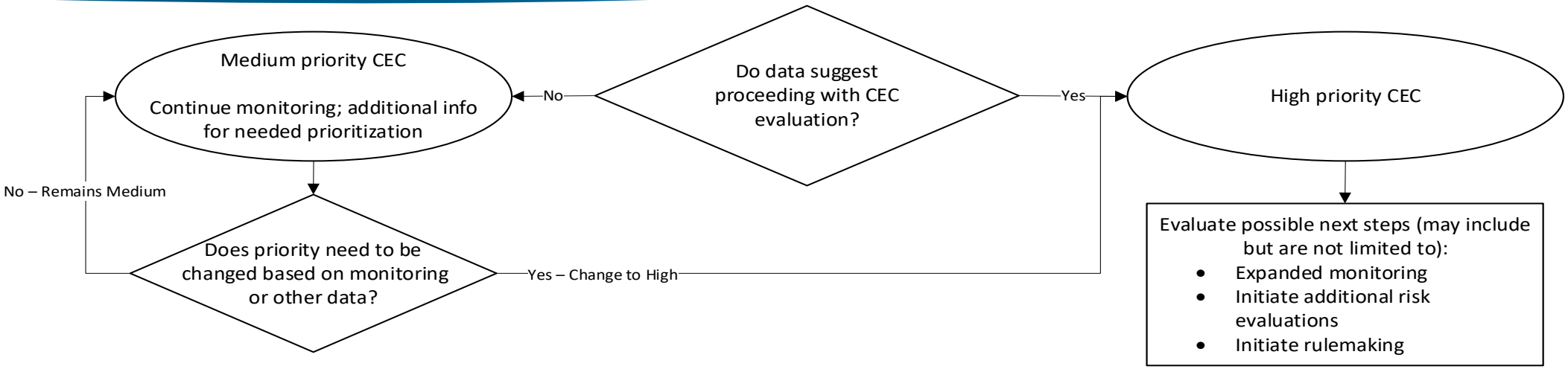
Poll Question

How would you prioritize this chemical: as a LOW, MEDIUM, or HIGH PRIORITY CEC?

A. Low priority CEC
B. Medium priority CEC
C. High priority CEC



Are there sufficient data to evaluate fate and transport?



- Consider data sufficiency – Based on your program requirements
- If "no" then need to collect data to inform fate and transport criteria and reassess
- If yes, then classify as "medium priority CEC" with a need for additional information (i.e., cannot rule out "high priority" yet)

or

- Classify as "high priority CEC"

CEC Prioritization

Chemical Name: Chloro-α,α,α-trifluorotoluene
CASRN: 98-56-6
Chemical Formula: $C_7H_4ClF_3$
Molecular Weight: 180.56

	LOW PRIORITY CEC	MEDIUM PRIORITY CEC	HIGH PRIORITY CEC
Summary of current data	no significant concern	additional information needed for further prioritization	widespread or significant concern
Monitoring Follow Up	no monitoring at this time	continued monitoring	expanded monitoring
Additional Steps	watch for new information	seek out new information that may inform a need for risk characterization	additional risk characterization and potential rulemaking

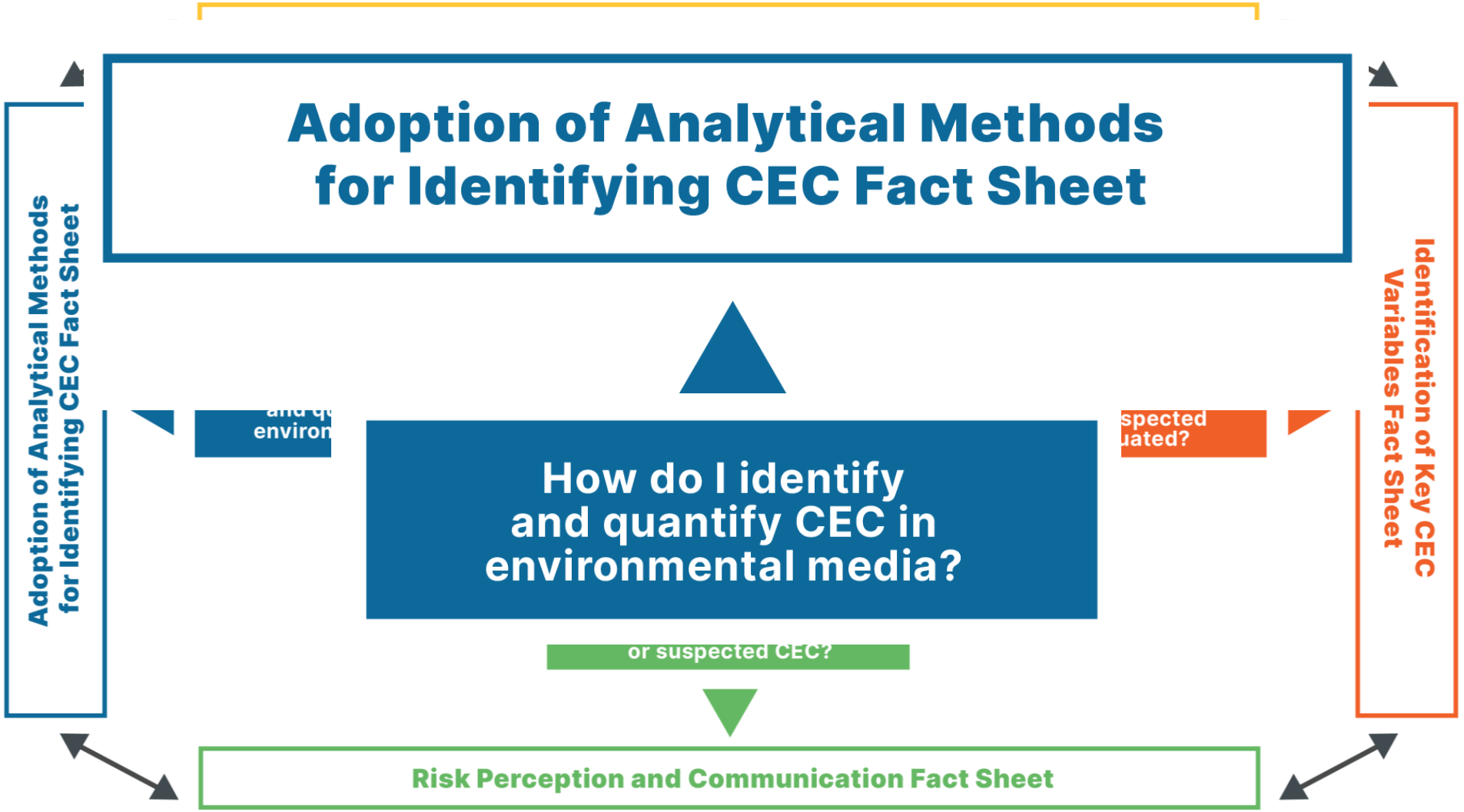
Communicating Medium Priority CEC

Present in the environment and has some toxicity or physical-chemical data

	Internal Audience	External Audience
Promote Action	• Advocate for continuing to expand data • Develop recommendations and communication plans focused on potentially susceptible populations	• Communicate known risks, particularly to impacted subgroups (e.g., potential for higher risk because of proximity, lifestyle, etc.) • Review and update informational resources
Reduce Outrage	• Communicate to decision makers the need for more information and steps being taken to protect impacted populations	• Continue to communicate changes with honesty, transparency and empathy

QUESTIONS

CEC Identification Framework



Fact Sheet: Analytical Methods for Identifying CEC

Fact Sheet Outline

- Individual Chemical Compound Analysis
  - Case Study 1: *p*-Chloro-α,α,α-trifluorotoluene as a tentatively identified compound (TIC)
  - Case Study 2: 6-PPD-q using Effect-Directed Analysis (EDA) & Non-Targeted Analysis (NTA)
- Analytical Methods for Chemical Classes
- Methods for Biological Contaminants
- Analysis of Particulates (Microplastics and Engineered Nanoparticles)

Resources

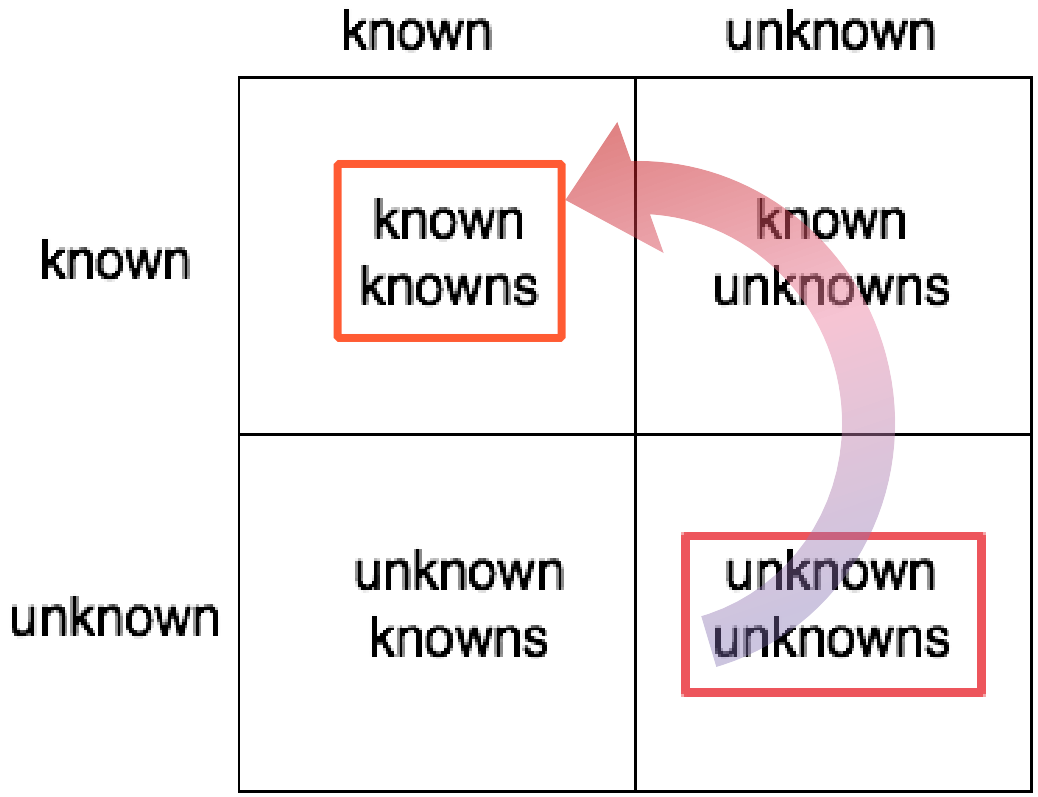
- Acronyms List
- Glossary of (Analytical) Terms
- Online Resources (Listed at the end of each section)

The CEC Problem: General

Known-Knowns: Aware of identity and/or effect of compound/substance.

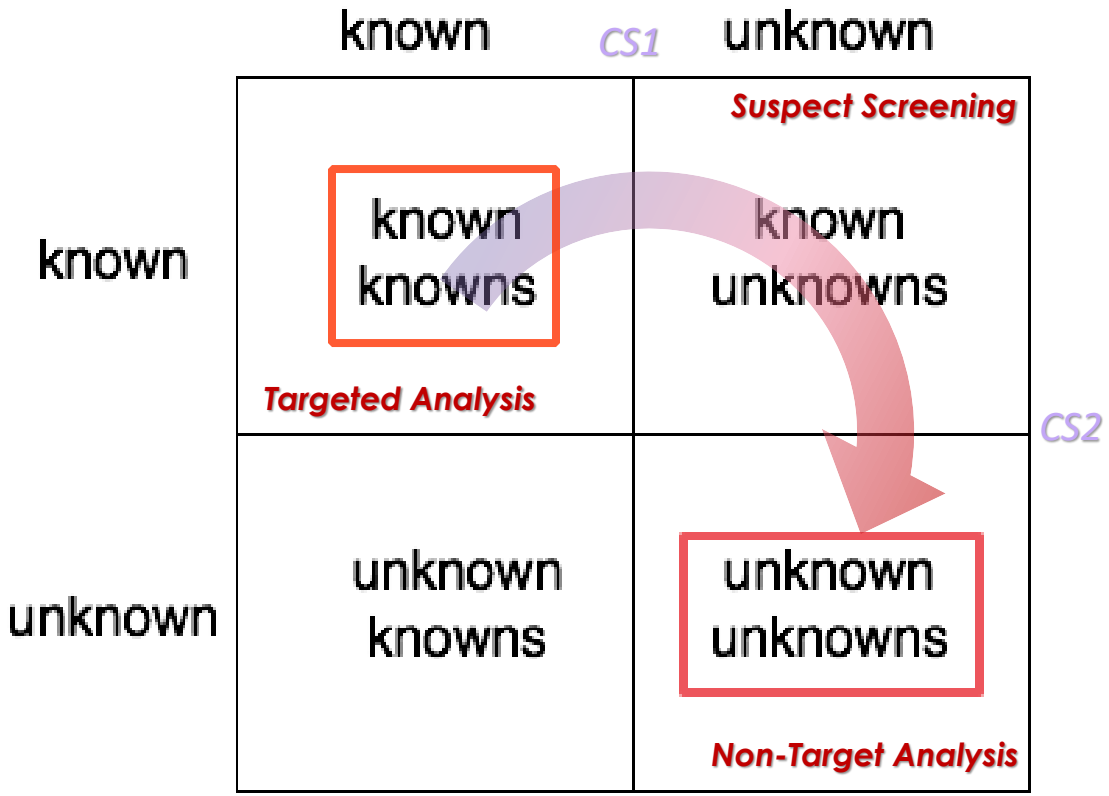
Known-Unknowns: Aware of CEC identity from different industries, or through similar compounds/substances.

Unknown-Unknown: Unaware of identity and/or effect of CEC.



Diminishing uncertainty over time!

The CEC Problem: Analytical Methods



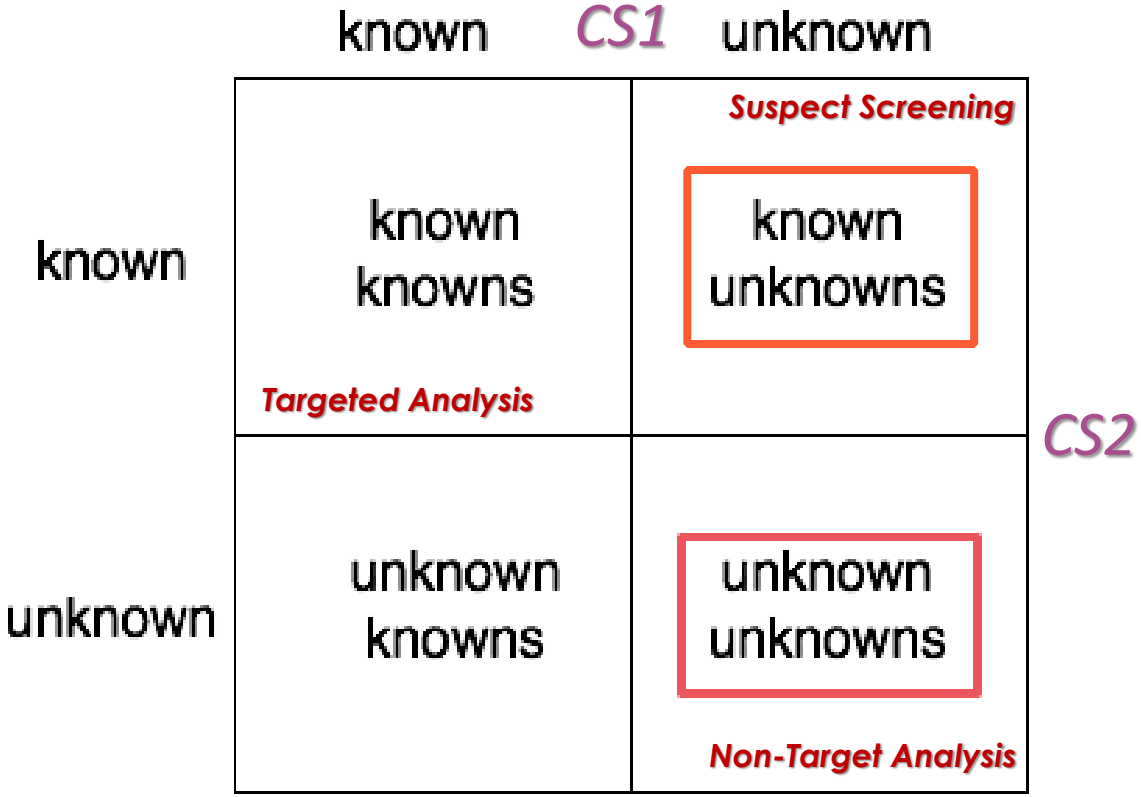
Known-Knowns: Aware of identity and/or effect of compound/substance. Has been previously characterized and quantified in environmental media: ***Targeted Analysis***

Known-Unknowns: Aware of CEC identity from different industries, or through similar compounds/substances. Has not been previously characterized and quantified in environmental media: ***Suspect Screening***

Unknown-Unknown: Unaware of identity and/or effect of CEC. Has not been previously characterized and quantified in environmental media: ***Non-Target Analysis***

Exhaust established targeted analysis methods before moving on to exploratory analysis

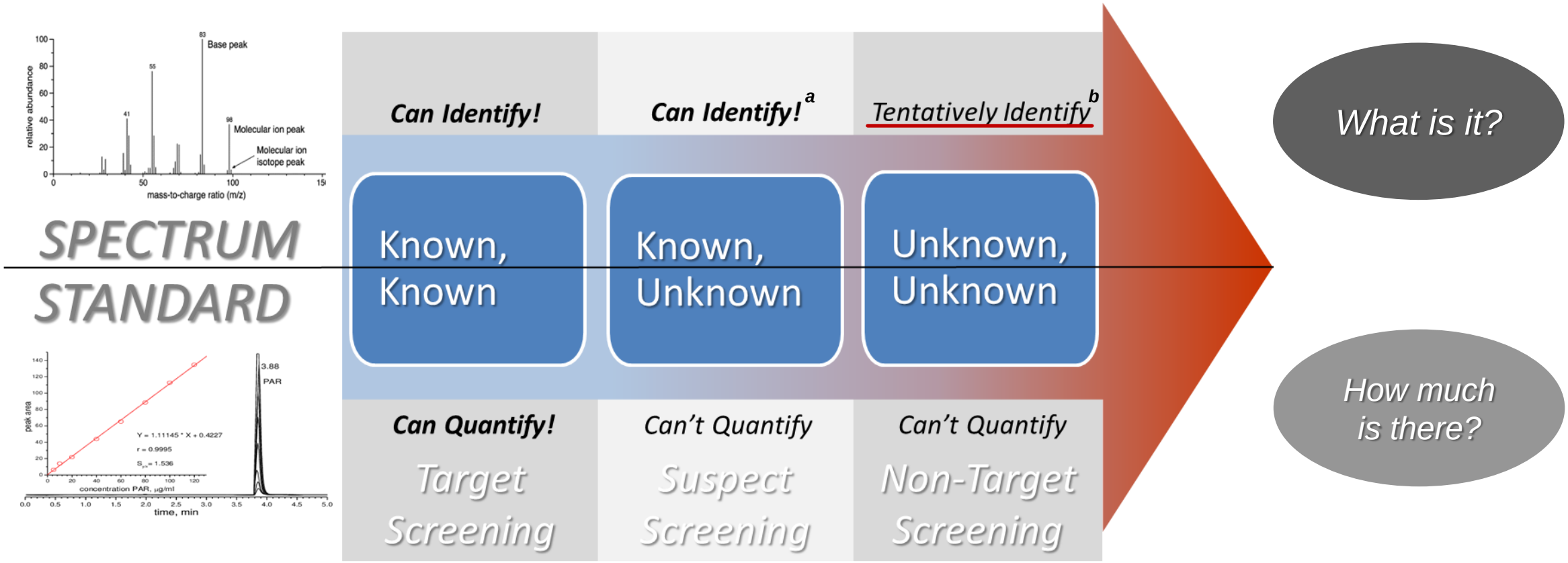
Categories of Analysis



Case Study 1 (CS1): *p*-Chloro-α,α,α-trifluorotoluene as a tentatively identified compound (TIC).

Case Study 2 (CS2): 6-PPD-q using Effect-Directed Analysis (EDA).

Analysis of Individual Compounds: Reference Materials



a. Spectrum might be available from a reference spectral library.

b. Molecular formula using High-Resolution Mass Spectrometry (HRMS)

Case Study 1: p-Chloro-α,α,α-trifluorotoluene as TIC

Known-Unknown: When spectrum is readily available

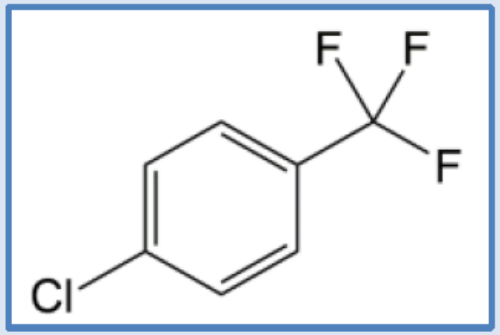
Step 1: Run targeted GC-MS method.

Step 2: Match against a reference spectral library.

Step 3: Spectral match >85% → Tentatively Identified Compound or "TIC" (USEPA).

Step 4: Acquire/synthesize chemical standard.

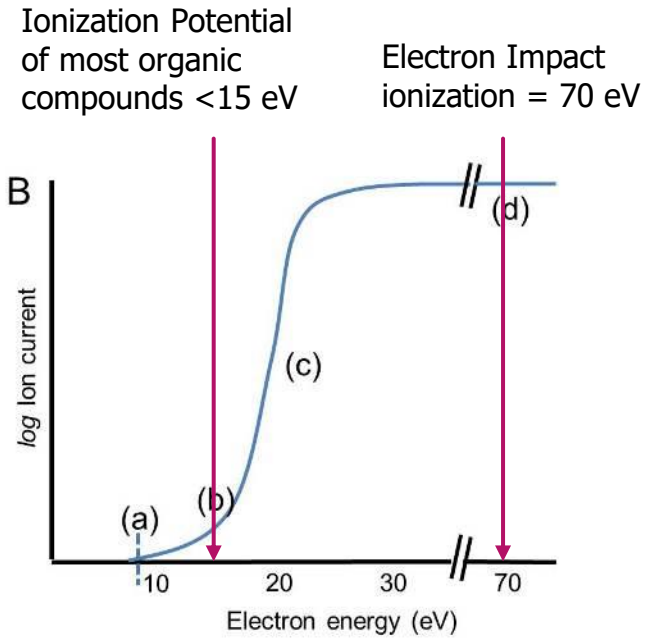
Step 5: Develop calibration curve, modify the targeted method for quantitation



Chemical Name:
Chloro-α,α,α-trifluorotoluene
CASRN: 98-56-6
Chemical Formula: $C_7H_4ClF_3$
Molecular Weight: 180.56
Boiling Point: 140 °C

GC-MS vs. LC-MS: Ionization & Spectral Libraries

GC-MS	LC-MS
"Strong" ionization (e.g., Electron Impact, EI)	"Soft" ionization (e.g., electrospray ionization, ESI)
High ionization efficiency*	Lower ionization efficiency*
Tolerant of matrix effects	Sensitive to matrix effects
Highly reproducible fragmentation	Variable fragmentation
Yields platform-independent reference spectral libraries (e.g., Wiley-NIST)	Spectral libraries developed by each lab for each instrument



**Ionization Efficiency α No. of ions generated / No. of molecules consumed*

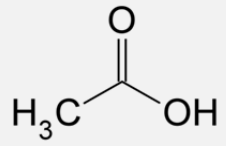
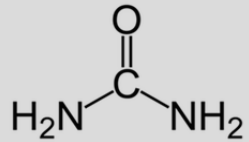
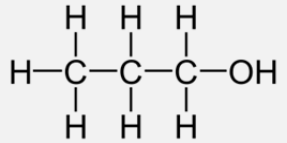
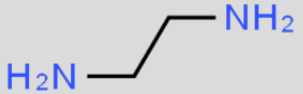
HRMS: Accurate Mass of Molecular Ion Peak

Unknown-Unknown:
No spectrum available

"A unique molecular formula (or fragment formula) can be derived from a sufficiently accurate mass measurement alone using high-resolution mass spectrometry"

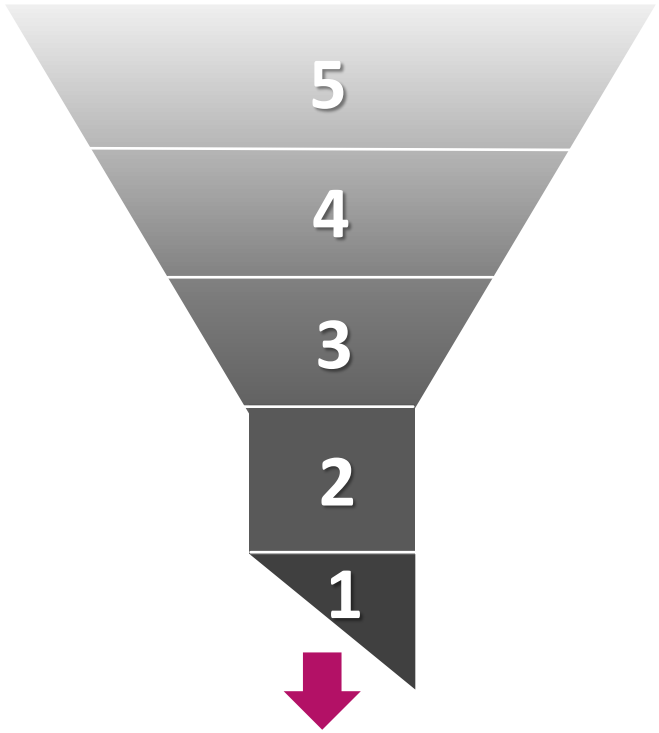
- Silverstein et al., 2014

Element	Nominal Mass	Accurate Mass
C	12	12.000000
H	1	1.007825
N	14	14.003074
O	16	15.994914

Compound	Nominal Mass[a]	Accurate Mass[b]
 Acetic Acid ($C_2H_4O_2$)	60	60.021128
 Urea (CH_4N_2O)	60	60.032362
 Propan-1-ol (C_3H_8O)	60	60.057514
 Ethylenediamine ($C_2H_8N_2$)	60	60.068748
	Same	***Different!***

Schymanski Scale: Confidence in Identification via HRMS

Tentative Identification of Unknown-Unknowns



Level 5: Exact mass of interest (m/z)	*(MS)*
Level 4: Unequivocal Molecular Formula	*(MS, Isotopic Match)*
Level 3: Tentative Candidate(s)	*Structure, Substituent, Class (MS, MS^2, Experimental Data*)*
Level 2: Probable Structure	*Library Match (MS, MS^2, Library MS^2) Diagnostic Evid. (MS, MS^2, Exp. Data*)*
Level 1: Confirmed Structure	*Reference Standard (MS, MS^2, RT)*

Increasing Confidence in Identification

(e.g., in silico fragmentation data)*

Case Study 2: 6PPD-q by Effect-Directed Analysis + NTA (1/3)

Background

Urban Runoff Mortality Syndrome (URMS):

- Acute mortality in coho salmon observed in the Pacific NW
- Occurs annually when coho salmon return to spawn in freshwaters located in urbanized watersheds
- Occurs during and following rainfall runoff events

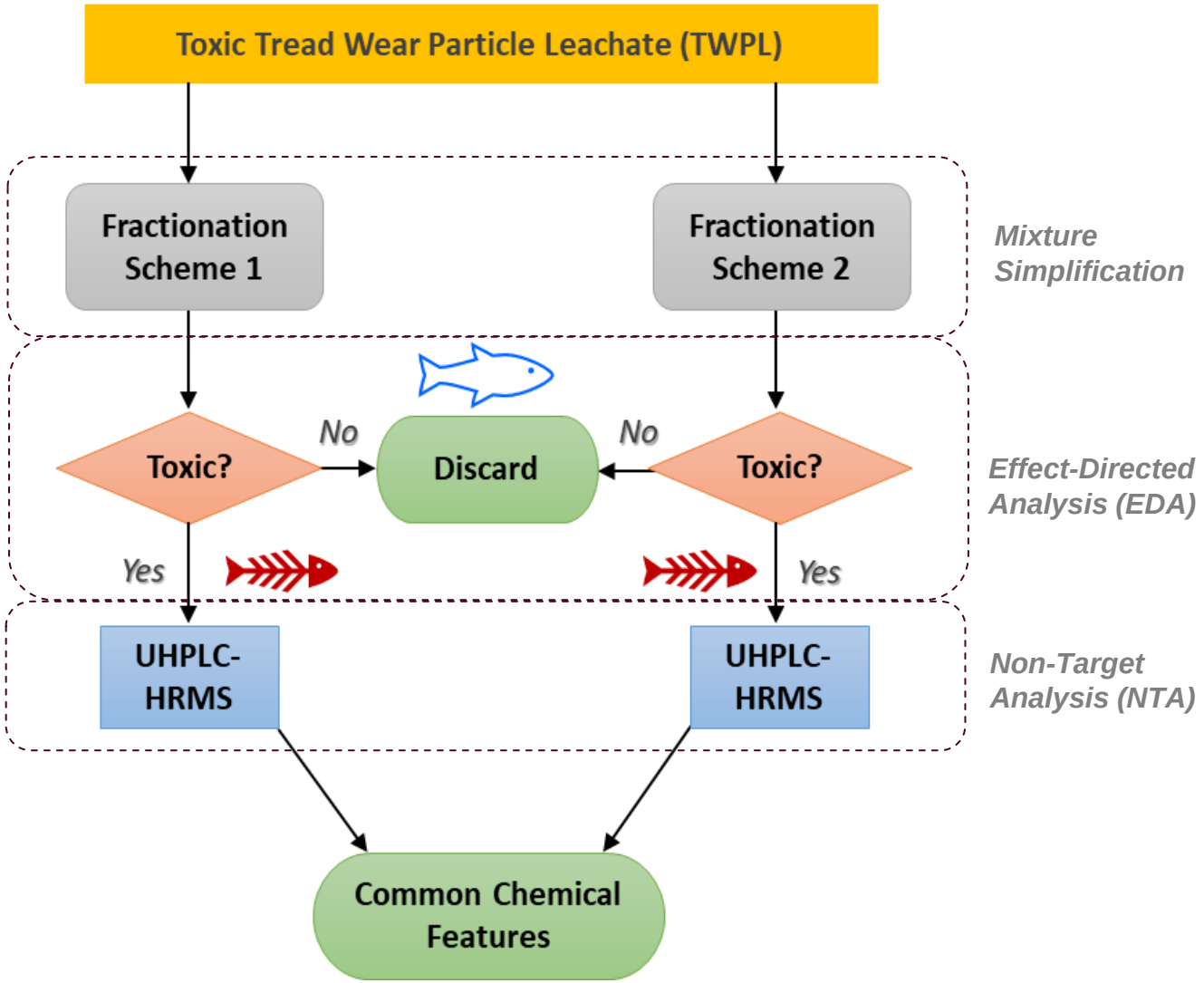
Tread Wear Particle Leachate (TWPL):

- TWPL is a complex aqueous leachate mixture of compounds produced from tread wear and tires
- This complex leachate found to cause mortality in coho

Other: Targeted methods exhausted

Figure source: ITRC Tire Anti-Degradants Committee

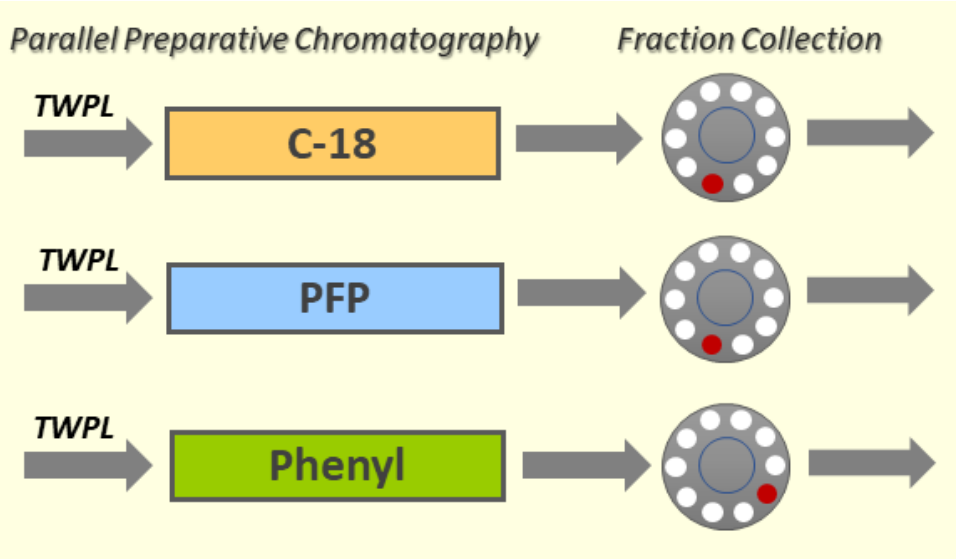
Case Study 2: 6PPD-q by Effect-Directed Analysis + NTA (2/3)



- Fractionation scheme: Preparative chromatography + Fraction collection.
- Effect-Directed Analysis (EDA): Testing of each fraction for a toxic effect (i.e., mortality in coho salmon).
- Pooling of Common "Features": Features are mass spectral (molecular ion) peaks from HRMS; common features from independent fractionation + EDA schemes were pooled.

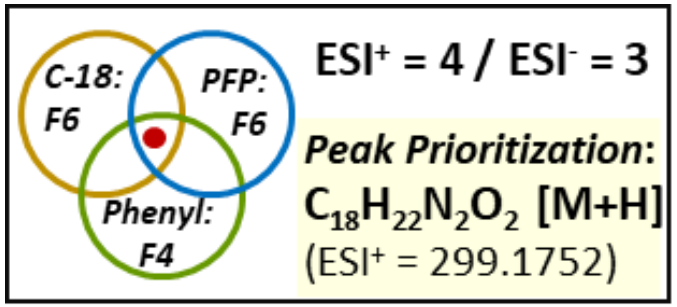
Case Study 2: 6PPD-q by Effect-Directed Analysis + NTA (3/3)

Mixture Simplification | **EDA** | **NTA**



UHPLC-HRMS

Pooling Common Chemical Features



Purification

UHPLC-HRMS

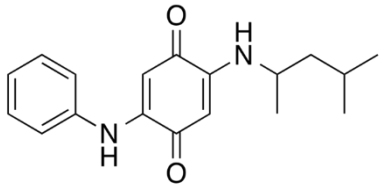
Monoisotopic Mass = 298.1681

$C_{18}H_{22}N_2O_2$

Molecular Formula
*Schymanski Level 5**

Additional Testing

6PPD-q

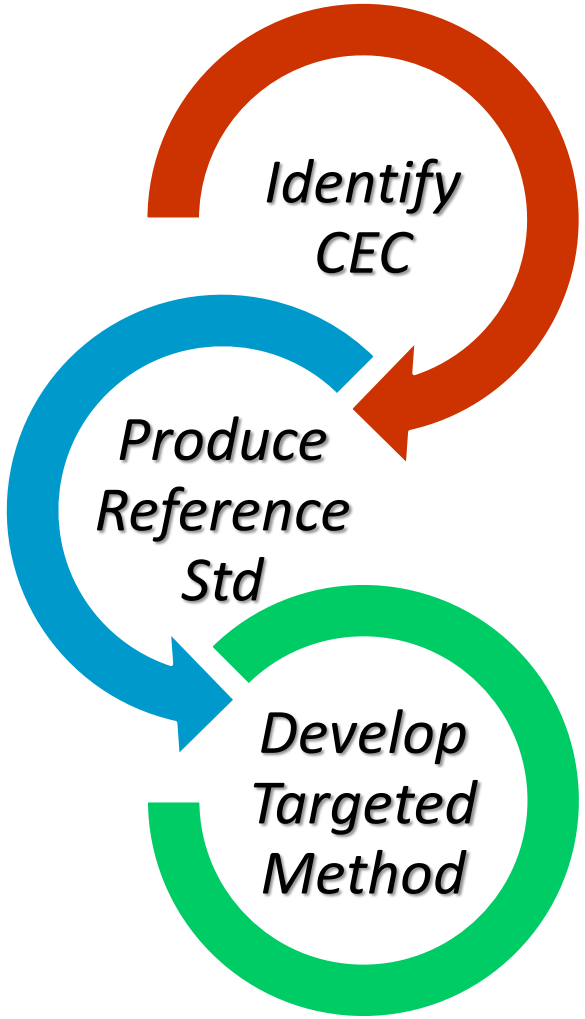


Structural Formula
*Schymanski Level 3**

ITRC CEC Analytical Methods Case Study (based on Tian et al., 2021)

** Based on HRMS alone*

What Next? CEC Analytical Lifecycle



- TIC identification by spectral library matching
- Suspect screening
- Non-target analysis

- Chemical synthesis
- Purification & characterization
- Mass production
- or, simply purchase if commercially available

- Targeted instrumental method development
- Detection issues in environmental matrices
- Sampling issues
- Validation

Chemical Class Analysis: PFAS

Total Fluorine (Organic & Inorganic)

- Particle-Induced γ-Ray Emission (PIGE)

Organic Fluorine

- ^{19}F Nuclear Magnetic Resonance (NMR)
- Adsorbable/Extractable Organic Fluorine (AOF/EOF) via CIC
  (e.g., USEPA Draft Method 1621)

PFAS Organic Fluorine

- Moody ^{19}F NMR
- *Suspect Screening via LC-HRMS - see Suspect & Non-Target Screening*
- Total Oxidizable Precursor (TOP) assay via Target Screening

PFAS Target Screening

- *ITRC CEC Analytical Methods, Sect. 2.1*
- *ITRC PFAS, Section 11*

EXAMPLES

USEPA Method 537
USEPA Method 537.1
USEPA Method 533
USEPA SW846 Method 8327
USEPA Draft Method 1633

Other CEC: Summary

Biological CEC [1,2]

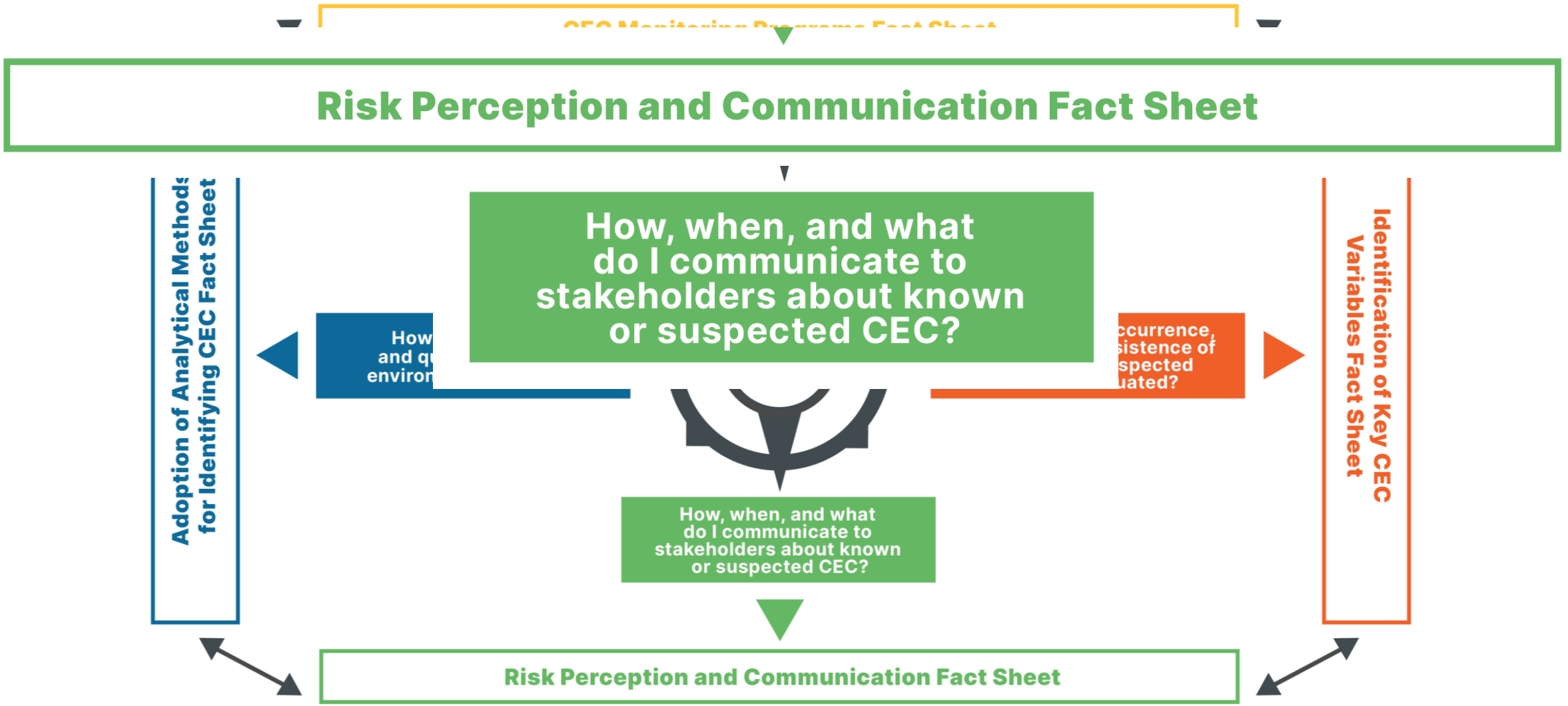
- Polymerase chain reaction (PCR)
- Quantitative PCR (qPCR)
- Metagenomics
- Meta transcriptomics
- Metabolomics
- Proteomics
- Microarrays
- Flow cytometry
- Culture-based methods

Particulates [3]

- Microplastics
- Engineered Nanoparticles (ENPs)

1. Builds on ITRC Environmental Molecular Diagnostics (EMD) Fact Sheet, 2013.
2. This topic will be explored further in the ITRC Committee entitled "CEC Identification Framework – Biologicals", scheduled to commence in 2024.
3. See ITRC Microplastics Fact Sheet, https://mp-1.itrcweb.org/.

CEC Identification Framework



Risk Communications Basics

Process involves:

- Identifying, understanding, and engaging your audience and stakeholders
- Defining clear messages specific to the audience and goal
- Using appropriate communication methods
- Adapting messaging based on learning from your audience
- Accepting the uncertainty and oftentimes communicating before "ideal" timing

Uncertainty Surrounding CEC

Messages coming from different sources could urge different levels of action

- Results from
  - Differences in selection and interpretation of key toxicity studies, choice of uncertainty factors, and approaches used for animal-to-human extrapolation
  - Different regulations among states
  - Different priorities among states or jurisdictions
  - Internet/Social media
- Confusing for individuals receiving multiple messages

What about "Risk"

Risk is not “one-size-fits-all”

- Objective risk vs. Subjective risk
- Example:
  - Regulators: "Is a contaminant present at a concentration higher than an enforceable standard?"
  - Member of the public: "How will this contaminant impact my health?"
- Effectively communicating risk requires understanding both viewpoints
  - Members of the public will have a variety of views driving their individual concerns

Methods of Communicating Risk

Two approaches (Sandman, 2007)

Must establish trust with the audience

- Honest, transparent, and empathetic
- If trust is broken, it will be difficult to communicate effectively

Precaution Advocacy

Encourage stakeholders to take action to reduce risk

Internal stakeholders may be a common audience in low or medium priority situations

- Subject matter experts may be the primary risk communicators in this scenario

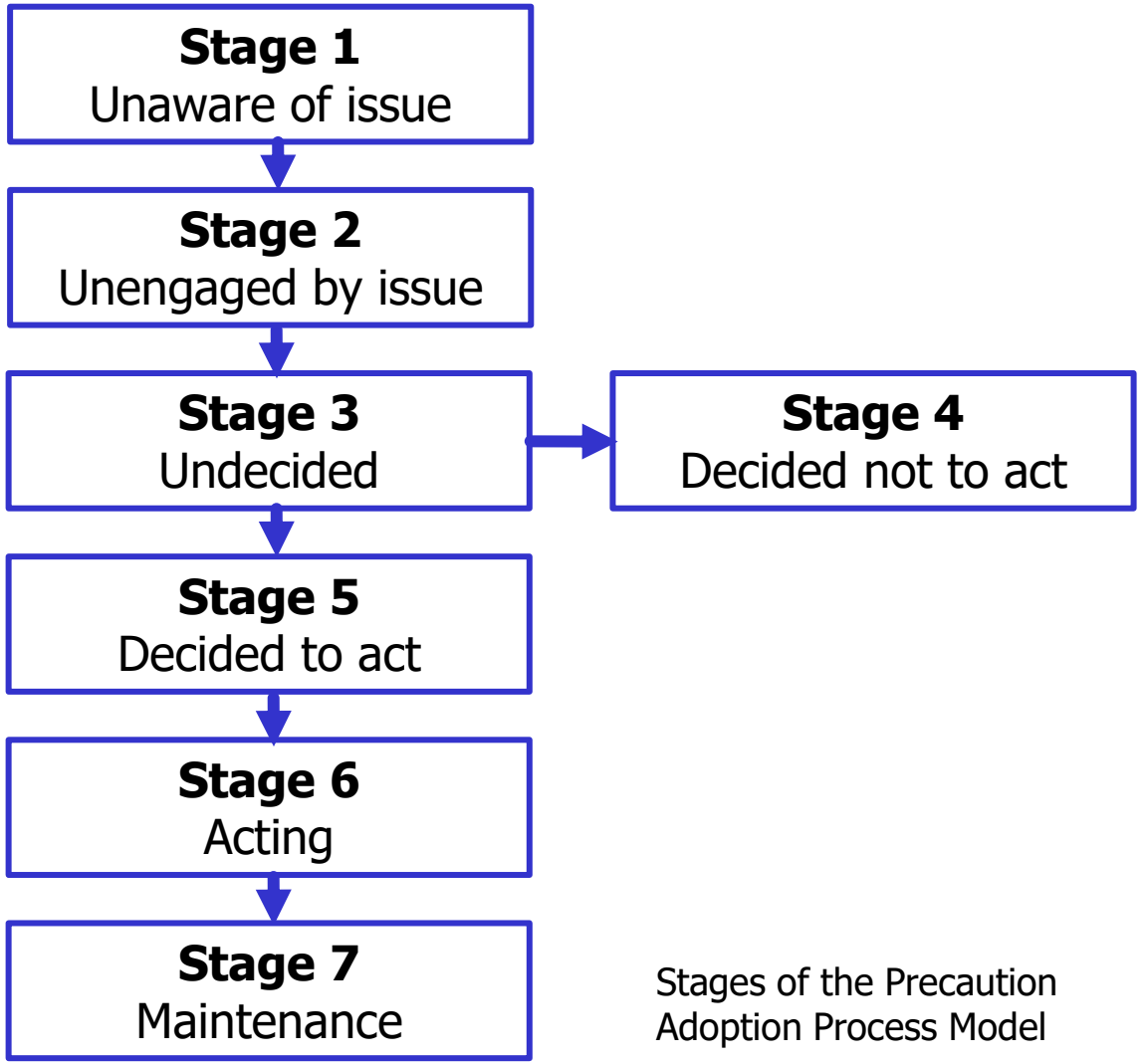
External stakeholders (i.e., "the public")

Precaution Adoption Process Model

Series of stages that people go through when deciding to act or not

Strategy will vary based on the stage of your audience

- Stages 1-2 may need basic education
- Stages 5-6 may just need guidance



Stages of the Precaution Adoption Process Model

Some Strategies for Precaution Advocacy

- Keep it short and interesting
- Stay on message
- Appeal to emotions
- Give people actionable steps

Outrage Management

Reduce stakeholder concern about a relatively low risk

Difficult when the audience is already stressed, angry, or concerned

- Information processing inhibited
- Worst-case thinking
- Distrust

Strategies for Outrage Management

Stake out the middle

- Start where the audience is
- Gives you an opportunity to change minds

Acknowledge problems

Best Practices

Messages specific for the situation

Communicate frequently and transparently

Acknowledge uncertainty of the situation

Maintain Honesty

Resources

- ITRC Risk Communications Toolkit
- EPA's SALT Framework
- CDC Crisis & Emergency Risk Communication
- ATSDR Risk Communications

Questions

Contaminants of Emerging Concern Identification Framework, cec-1.itrcweb.org

Certificate of Completion
https://www.clu-in.org/conf/itrc/CEC/
(emailed after you complete the Feedback Form)