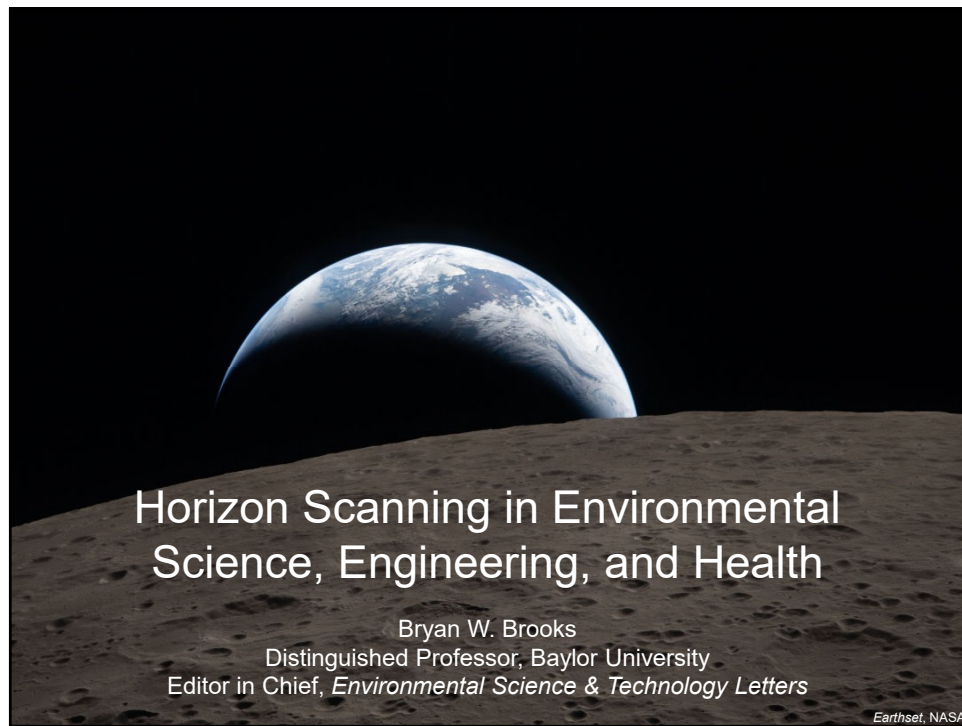




1

Why Horizon Scanning?

The Global Risks Report 2026
21st Edition
INSIGHT REPORT

Global risks ranked by severity, short term (2 years) and long term (10 years)
These estimates the likely impact severity of the following risks over a 2-year and 10-year period.

Short term (2 years)	Long term (10 years)
1. Geoeconomic confrontation	1. Extreme weather events
2. Misinformation and disinformation	2. Biodiversity loss and ecosystem collapse
3. Societal polarization	3. Critical changes to Earth systems
4. Extreme weather events	4. Misinformation and disinformation
5. State-based armed conflict	5. Adverse outcomes of AI technologies
6. Cyber insecurity	6. Natural resource shortages
7. Inequality	7. Inequality
8. Erosion of human rights and/or civil freedoms	8. Cyber insecurity
9. Pollution	9. Societal polarization
10. Involuntary migration or displacement	10. Pollution

Risks Perception Survey

Risk categories: Economic, Environmental, Geopolitical, Societal, Technological

Peering into the Future: How Horizon Scanning can help shape EU Policy

NEWS ARTICLE
19 January 2024 — Joint Research Centre — 4 min read

2

Why Horizon Scanning?

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3. Societal polarisation	3. Critical change to Earth systems
4. Extreme weather events	4. Misinformation and disinformation
5. State-based armed conflict	5. Adverse outcomes of AI technologies
6. Cyber insecurity	6. Natural resource shortages
7. Inequality	7. Inequality
8. Erosion of human rights across civil freedoms	8. Cyber insecurity
9. Pollution	9. Societal polarisation
10. Instability, migration or displacement	10. Pollution

Risks Perception Survey

Risk categories: Economic, Environmental, Geopolitical, Societal, Technological

espas.eu/horizon.html

ESPAS EUROPEAN STRATEGY AND POLICY ANALYSIS SYSTEM

Horizon Scanning

3

Why Horizon Scanning?

The Global Risks Report 2026
21st Edition
INSIGHT REPORT

Global risks ranked by severity, short term (2 years) and long term (10 years)
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9. Pollution	9. Societal polarisation
10. Instability, migration or displacement	10. Pollution

Risks Perception Survey

Risk categories: Economic, Environmental, Geopolitical, Societal, Technological

A horizon scan of biological conservation issues for 2025

William J. Sutherland^{1,*}, Peter N.M. Brotherton², Holly M. Buttenworth³, Stewart J. Clarke⁴, Tammy E. Davies⁵, Nigel Doer⁶, Nafessa Esmail⁷, Erica Fleishman⁸, Kevin J. Gaston⁹, James E. Herbert-Read¹⁰, Alice C. Hughes¹¹, Jonathan Hughes¹², Hermann Kaartokallio¹³, Lian Pin Koh¹⁴, Ritesh Kumar¹⁵, Fiona A. Lickorish¹⁶, Hannah Litter¹⁷, James E. Palardy¹⁸, James W. Pearce-Higgins^{1,19}, Lloyd S. Peck²⁰, Nathalie Pettorelli²¹, Jules Pretty²², Irene R. Schloss^{23,24,25}, Mark D. Spalding^{1,26}, Dirk ten Brink²⁷, Eleanor R. Tew^{1,28}, Anastasiya Timoshyna²⁹, Nicolas Tubbs³⁰, James E.M. Watson³¹, Jonathan Wentworth³², Jeremy D. Wilson³³, and Ann Thornton³⁴

Sutherland et al 2025. *Trends Ecol Evol*

4

Table 1. A taxonomy of horizon-scanning methods used in identifying and prioritising future possible issues*					
Scanning stage	Method	Approach	Strengths	Weaknesses	Examples
Scoping	Interviews	One-to-one questioning (usually of senior experts or stakeholders) to identify issues and explore important driving forces and areas of uncertainty; can be highly structured, with no debate (e.g. '7 questions'), or open and involve discourse	Well understood, so generally accepted; techniques good at getting key individuals' perspectives on the future	No interaction among individuals with an interest or expertise	Environmental Research Funders Forum Horizon Scanning Study [19]
	Issue tree	Breaks down key question into a mutually exclusive and completely exhaustive set of sub-questions	Identifies the information needed to provide a complete answer to the key question	Less suitable for general or imprecisely scoped issues	Foresight project on Brain Science, Addiction and Drugs (http://www.foresight.gov.uk/OurWork/CompletedProjects/Brain%20Science/index.asp)
Gathering information	Literature searches and state-of-science reviews	Search for published threats and opportunities	Makes use of only published evidence (which might have been peer-reviewed)	Can be backward-looking unless a deliberate effort is made to produce outlooks of the future (as in Sigma Scan)	Literature search: Sigma Scan commissioned by UK Government Office for Science's Foresight's Horizon Scanning Centre. (http://www.sigmascan.org)
	Expert workshops	Bring together team of experts to suggest possible issues based on their own experience and knowledge of the literature	Use of experts provides credibility; interactive nature of workshops draws out deep (or partially formed) ideas, and refines issues	Findings will depend on who is involved; can also depend on process used to elicit their knowledge	State-of-science reviews: any Foresight project (http://www.foresight.gov.uk)
	Open fora	Contributions by anyone into, for example, an on-line forum (such as Wikipedia)	Makes use of 'wisdom of crowds', and, potentially, broadest possible range of contributors	Lacks a rigorous system for ensuring quality of entries	Horizon scan of conservation issues in UK [11]. Assessment of 100 ecological questions of highest priority to global conservation [16] Delta (Science and Technology) Scan commissioned by UK Government Office for Science's Foresight Horizon Scanning Centre (now incorporated in their Sigma Scan) (http://www.sigmascan.org)
Spotting signals	Delphi questionnaire	Consultation of experts through questionnaire (usually two-stage)	Good at providing overview of what is happening in an area of science	Not interactive	Future Wikia (http://future.wikia.com/wiki/Main_Page) http://signific.org/
Watching trends	Trend analysis	Study historic performance to identify future trends	Aids identification and understanding of drivers	Past performance is not necessarily a guide to the future	The Millennium Project's Global Energy Scenarios (http://www.acunu.org/millennium/energy-delphi.html)
Making sense	Scenarios	Consider a range of possible future states and then explore the possible consequences of each	Helps organisations prepare for change, and test robustness of current strategies	Require substantial resources (time and expertise) to produce	A State of the Nation's Ecosystems 2008 [20] (http://www.heinzcenter.org/ecosystems/)
	Systems maps	Show the relationships between all factors influencing the central issue, and whether their effect is positive or negative	Provides an understanding of the range of issues influencing the central issue	Requires pre-existing knowledge	Wildlife Conservation Societies' Futures of the Wild [21]
Agree the response	Backcasting	Describe a vision of the preferred future, then identify the key steps needed to reach it	Can be done as a stand-alone exercise	Requires careful structuring to identify all relevant factors	Foresight project on Tackling Obesity: Future Choices (http://www.foresight.gov.uk/OurWork/ActiveProjectsObesity/Obesity.asp)
*Some non-environmental examples are given to illustrate how the method could be applied. Foresight's 'toolkit' of futures techniques (http://www.foresight.gov.uk/toolkit) gives further methods and a range of case studies.					

Sutherland and Woodroof. 2009. *Trends Ecol Evol*

5

Why Horizon Scanning?

Environmental Public Health Practice



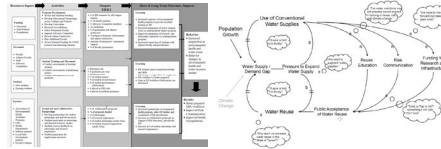
FACT SHEET

National Center for Environmental Health
Division of Emergency and Environmental Health Services

CDC Environmental Public Health Leadership Institute

The Centers for Disease Control and Prevention (CDC) Environmental Public Health Leadership Institute (EPHLI) is a year-long leadership development program for environmental health practitioners. Fellows participate in two in-person workshops, complete assignments, and develop a systems-thinking project on an environmental health issue. Each year, about 30 practicing environmental public health professionals are admitted to the institute. CDC coordinates this through a partnership with the National Public Health Leadership Development Network.





Environmental Public Health Leadership Institute
Environmental Health Scan Primary Reading List

Four articles in Reading List #1: Scanning and Emerging Environmental Issues

Munn, T., Timmerman, P., & Whyte, A. (2000). Emerging environmental issues. *Bulletin of the Meteorological Society*, 81(7), 1603-1609.

Kyle, A.D., Woodruff, T. J., & Axelrad, D.A. (2006). Integrated assessment of environment and health: America's children and the environment. *Environmental Health Perspectives*, 114 (3), 447-452.

Craft, E. S., Donnelly, K. C., Neamtiu, I., McCarthy, K. M., Bruce, E., Surkova, L., Kim, D., Ushakova, L., Gyorfy, E., Tesarova, E., & Anderson, B. (2006). Prioritizing environmental issues around the world. *Epigeia* from an international central and eastern European environmental health conference. *Environmental Health Perspectives*, 114 (2), 1813-1817.

Center for Technology in Government. (2003). And justice for all: Designing your business case for integrating justice information. Retrieved April 15, 2008 from <http://www.ctg.albany.edu>.

Two articles in Reading List #2: EPA Reports

U.S. Environmental Protection Agency. (2005). Children's health and the environment in North America: A first report on available indicators and measures. Country report. United States, Washington, D.C.

Milanes, C., Morry, D., Parker, T., Ricker, K. (1999, February). California's emerging environmental challenges: A workshop to identify future issues for CalEPA. Sacramento, California: Environmental Protection Agency, Office of Environmental Health Hazard Assessment.

6

Why Horizon Scanning?

Environmental Public Health Practice



Commentary

A Section 508-conformant HTML version of this article is available at <https://doi.org/10.1289/EHP5161>.

Environmental Health Practice Challenges and Research Needs for U.S. Health Departments

Bryan W. Brooks,¹ Justin A. Gerding,² Elizabeth Landeen,³ Eric Bradley,⁴ Timothy Callahan,⁵ Stephanie Cushing,⁶ Fikru Hailu,⁷ Nancy Hall,⁸ Timothy Hatch,⁹ Sherise Juries,¹⁰ Martin A. Kalis,² Kaitlyn R. Kelly,¹ Joseph P. Lazo,² Niki Lemis,¹¹ Carol McInnes,¹² Greg Olsen,¹³ Robert Stratman,¹⁴ Carolyn White,¹⁵ Steven Wille,¹⁶ and John Sarisky²



<https://www.cdc.gov/environmental-health-practice/php/data-research/uncover-eh/index.html>

Brooks et al. 2019. *Environ Health Perspect*; Gerding et al. 2019. *JEH*; Gerding et al. 2020. *AJPH*

7

Why Horizon Scanning?

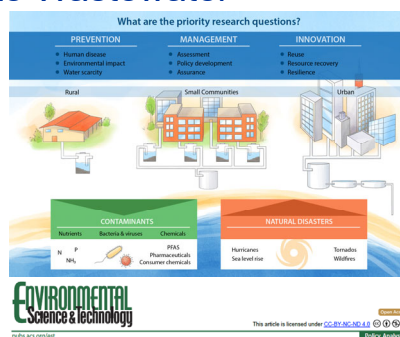
Needs for Onsite Wastewater



Identifying Workforce Education, Training, and Outreach Needs in Decentralized Wastewater and Distributed Water Reuse

Abstract Although decentralized wastewater and distributed water reuse professionals represent a key part of environmental public health and environmental engineering, an understanding of workforce challenges has remained elusive. Here we begin to address the critical need of understanding education, training, and outreach needs for decentralized wastewater and distributed water reuse. We specifically engaged professionals working in health departments and other government agencies, industry, academia, and nongovernmental organizations. We examined workforce characteristics related to education, training, and outreach. We found that 17% of decentralized wastewater and distributed water reuse professionals plan to retire within 5 years, approximately 33% of these professionals do not hold any type of certification, and education and training are insufficient to meet current workforce demands. We further report 10 problem statements associated with timely education, training, and outreach needs, which represent important opportunities for improving the practice of decentralized wastewater and distributed water reuse. Strategic education, training, and outreach activities are necessary to ensure workforce preparedness, to promote education with owners of onsite technologies, and to expand advanced training and transitional research programs in decentralized wastewater and distributed water reuse. Our findings can specifically support decision making aimed at sustaining and advancing the decentralized wastewater and distributed water reuse workforce.

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Systems Research, Oyster University
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Department of Biological and Agricultural
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Jeffrey Mueller, MS, PE
The Water Research Foundation
Wesley Moore, MS, PE
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Control and Prevention
Christopher Walker, MS, PhD
National Environmental
Health Association
Harry Zhang, PhD, PE
The Water Research Foundation
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Environmental Science Program,
Department of Environmental Science,
Rutgers University
Sara F. Heger, MS, PhD
Water Resources Center,
University of Minnesota
Bryan W. Brooks, MS, PhD
Center for Research and Aquatic
Systems Research, Oyster University
Environmental Health Science Program,
Department of Environmental Science,



Identifying Priority Research Questions for Decentralized Wastewater

Bryan W. Brooks,¹ Timothy Callahan, Jacob K. Stanley, Jamie Holadok, Kevin M. Stroski, Allison H. Cox, Thomas W. Groves, Anish Jantirana, Jeff C. Mueller, Kris Neist, Christopher Walker, Harry Zhang, Anish Bakchan, Kelly D. Alley, Jim Bell, Allison Blodig, Eric Casey, Donna Cooper, Victor D'Amato, Mark A. Elliott, Greg Groves, Roxanne Groover, Robert Himeschoot, Mary G. Lusk, Jillian Macy-Brown, David Meints, Rojello Mejia, Matt Pace, Benjamin J. Ryan, Brian Scheffe, Tom Schindelfing, June E. Wolfe, and Sara F. Heger

Chia This Environ. Sci. Technol. 2026, 60, 49–63

Read Online

Holadok et al. 2023. *JEH*; Brooks et al. 2026. *ES&T*

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Why Horizon Scanning?

Pharmaceuticals and Personal Care Products


 Environmental Toxicology and Chemistry, Vol. 28, No. 12, pp. 3469-3472, 2009
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 Printed in the USA
 0730-7268/09 \$12.00 + .00

Pharmaceuticals and Personal Care Products in the Environment
 Editorial

PHARMACEUTICALS AND PERSONAL CARE PRODUCTS: RESEARCH NEEDS FOR THE NEXT DECADE

 Environmental Health Perspectives

Pharmaceuticals and Personal Care Products in the Environment: What Are the Big Questions?

Alistair B.A. Boxall,¹ Murray A. Rudd,¹ Bryan W. Brooks,² Daniel J. Caldwell,³ Kyungho Choi,⁴ Silke Hickmann,⁵
 Elizabeth Innes,⁶ Kim Ostapyk,⁶ Jane P. Staveley,⁷ Tim Verslycke,⁸ Gerald T. Ankley,⁹ Karen F. Beazley,¹⁰
 Scott E. Belanger,¹¹ Jason P. Berninger,² Pedro Carriquiriborde,¹² Anja Coors,¹³ Paul C. DeLeo,¹⁴ Scott D. Dyer,¹¹
 Jon F. Ericson,¹⁵ François Gagné,¹⁶ John P. Giesy,¹⁷ Todd Gouin,¹⁸ Lars Hallstrom,¹⁹ Maja V. Karlsson,¹
 D. G. Joakim Larsson,²⁰ James M. Lazorchak,²¹ Frank Mastrocco,¹⁵ Alison McLaughlin,² Mark E. McMaster,²²
 Roger D. Meyerhoff,²³ Roberta Moore,² Joanne L. Parrott,² Jason R. Snape,²⁴ Richard Murray-Smith,²⁴
 Mark R. Servos,²⁵ Paul K. Sibley,²⁶ Jürg Oliver Straub,²⁷ Nora D. Szabo,²⁸ Edward Topp,²⁹ Gerald R. Tetreault,²⁵
 Vance L. Trudeau,²⁸ and Glen Van Der Kraak²⁶

Environmental Toxicology and Chemistry—Volume 43, Number 3—pp. 481-487, 2024
 Received 10 January 2024 | Accepted 16 January 2024

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Introduction

Pharmaceuticals and Personal Care Products in the Environment: What Progress Has Been Made in Addressing the Big Research Questions?

Alistair B. A. Boxall^{1*} and Bryan W. Brooks²
¹Department of Environment and Geography, University of York, York, United Kingdom
²Department of Environmental Science, Center for Resilient and Adaptive Systems Research, Institute of Biomedical Studies, Baylor University, Waco, Texas, USA

Brooks et al. 2009. *Environ Toxicol Chem*; Boxall et al. 2012. *Environ Health Perspect*; Boxall and Brooks. 2024. *Environ Toxicol Chem*

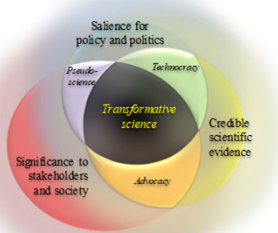
9

Why Horizon Scanning?

Key Questions Approach

- Engages experts across disciplines and sectors
- Systematic way to identify major research and policy directions
- These are inherently bottom-up exercises

potentially more legitimacy



Brooks et al. 2013. *IEAM*; Rudd et al. 2014. *IEAM*

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Why Horizon Scanning?

Towards Sustainable Environmental Quality

Environmental Toxicology and Chemistry—Volume 37, Number 5—pp. 1081–1095, 2018 Received 5 April 2017 Revised 26 April 2017 Accepted 11 June 2017	1081	Integrated Environmental Assessment and Management—Volume 14, Number 5—pp. 364–377 Received 23 April 2017 Received for Review 14 August 2017 Accepted 19 November 2017	364
Critical Review		Environmental Policy & Regulation	
Toward Sustainable Environmental Quality: Priority Research Questions for Europe		Toward Sustainable Environmental Quality: Identifying Priority Research Questions for Latin America	
Paul J. Van den Brink, ^{1*} Alistair B. A. Boxall, ² Lorraine Maltby, ³ Bryan W. Brooks, ⁴ Murray A. Rudd, ⁵ Thomas Buchwalter, ⁶ David Spurgeon, ⁷ Victoria Ieromenghini, ⁸ Chantana Ajeer, ⁹ Gerald T. Ankley, ¹⁰ Salma E. Aydin, ¹¹ Gaby Arnold, ¹² Tomas Broder, ¹³ Miguel Canabarro-Angulo, ¹⁴ Jennifer Chapman, ¹⁵ Jose Corralles, ¹⁶ Maria Agustin Cuadras, ¹⁷ Teresa F. Fernandez, ¹⁸ Joriker Fick, ¹⁹ Alex F. Ford, ²⁰ Gennaro Giordano, ²¹ Kasia J. Glick, ²² Thomas A. Hachmann, ²³ Heidi Krüger, ²⁴ Juan V.E. Kulkarni, ²⁵ Barbara Lunden, ²⁶ Stuart Marshall, ²⁷ David Muir, ²⁸ Manuel E. Ortiz-Santesteban, ²⁹ Kai B. Paul, ³⁰ Andrew Rios, ³¹ Samuel Rodas-Falmer, ³² Jörg Runkler, ³³ Tomas Rydgren, ³⁴ Naima Sørensen, ³⁵ Malin Sten, ³⁶ Cornelia A.M. van Gorkel, ³⁷ Marco Vighi, ³⁸ Inge Wæver, ³⁹ Elke J. Zinnius, ⁴⁰ and John van Wassen ⁴¹		Tatiana Heid Furlley, ¹ Julie Brodeur, ² Helene C. Silva de Assis, ³ Pedro Carraguiribordo, ⁴ Katia R. Chagas, ⁵ Jone Corralles, ⁶ Marina Denaldi, ⁷ Julio Fuchs, ⁸ Renata Macarenha, ⁹ Karina S.M. Migliorini, ¹⁰ Diana Margarete Miguel-Camacho, ¹¹ José María Naves, ¹² Daywitt Nogueira, ¹³ Estela Pineda, ¹⁴ Ignacio Abigardo Rodriguez-Juarez, ¹⁵ Mortha Oracio Medina, ¹⁶ Alistair B.A. Boxall, ¹⁷ Murray A. Rudd, ¹⁸ and Bryan W. Brooks ¹⁹	
Environmental Toxicology and Chemistry—Volume 38, Number 6—pp. 1626–1634, 2019 Received 12 February 2019 Received 19 March 2019 Accepted 14 May 2019	1626	Workshop Synthesis	
Critical Review		Towards Sustainable Environmental Quality: Priority Research Questions for the Australasian Region of Oceania	
Toward Sustainable Environmental Quality: Priority Research Questions for North America		Sally Galloway, ¹ Andrew Harford, ² Vincent Pettigrove, ³ Graham Soville-Jones, ⁴ Therese Manning, ⁵ James Atkins, ⁶ Tom Crosswell, ⁷ Katherine A. Daffron, ⁸ Frederic D. Leszczynski, ⁹ Bradley Maybridge, ¹⁰ Marcus Cammer, ¹¹ John Chapman, ¹² Gary Coates, ¹³ Anne Colville, ¹⁴ Claire Death, ¹⁵ Kimberley Hayman, ¹⁶ Kathryn Hazell, ¹⁷ Molly Hoek, ¹⁸ Jennifer Gault, ¹⁹ Christine J. Johns, ²⁰ Ali Karim, ²¹ Konstantinos Kotzakoulakis, ²² Richard Lox, ²³ Nicole McRae, ²⁴ Leon McKeown, ²⁵ Thomas Murray, ²⁶ Jacki Munn, ²⁷ Andrew Pearson, ²⁸ Mena Savaris, ²⁹ Dave Sharkey, ³⁰ Julia Stalder, ³¹ Oliver Sutherland, ³² Oliver Thomas, ³³ Louis Tremblay, ³⁴ Wolfgang Wondolowski, ³⁵ Alistair B. Boxall, ³⁶ Murray A. Rudd, ³⁷ and Bryan W. Brooks ³⁸	
Anna Fairbrother, ¹ David Muir, ² Keith R. Solomon, ³ Gerald T. Ankley, ⁴ Murray A. Rudd, ⁵ Alistair B.A. Boxall, ⁶ Jennifer B. Apple, ⁷ Kasia J. Glick, ⁸ Benita J. Bland, ⁹ Scott R. Bower, ¹⁰ Linda M. Campbell, ¹¹ George P. Cobb, ¹² Kristin A. Corcoran, ¹³ David A. Deane, ¹⁴ Mahesh S. Evans, ¹⁵ Carol J. Henry, ¹⁶ Robert A. Hult, ¹⁷ Nigel Huxley, ¹⁸ Stephen J. Klemm, ¹⁹ Rebecca D. Kiser, ²⁰ Oliver A. Kuhn, ²¹ Katarina J. Linn, ²² Charles Meyer, ²³ Mary Ann O'Shea, ²⁴ Elise O'Connor, ²⁵ John A. Pridmore, ²⁶ Robert C. Phipps, ²⁷ Kenneth R. Rhee, ²⁸ Gabriela Rodriguez-Fernandez, ²⁹ Alan Sarrett, ³⁰ Joseph R. Shaw, ³¹ Jeffrey A. Stowen, ³² Tim A. Vandenbergh, ³³ Doris E. Vold-Douglas, ³⁴ Scott M. Wain, ³⁵ Peter Wilson, ³⁶ and Bryan W. Brooks ³⁷		Environmental Toxicology and Chemistry—Volume 38, Number 6—pp. 1635–1645, 2019 Received 11 March 2019 Received 1 April 2019 Accepted 21 May 2019	1635
Critical Review		Toward Sustainable Environmental Quality: Priority Research Questions for Asia	
Toward Sustainable Environmental Quality: Priority Research Questions for Asia		Kenneth M.Y. Leung, ^{1,2*} Kate W.Y. Young, ³ Jing Yu, ⁴ Kyunghe Choi, ⁵ Xianwen Zhang, ⁶ Ross Smith, ⁷ Guangde Zhou, ⁸ Mark M.H. Tang, ⁹ Carlos Jose Barrios, ¹⁰ Yoon-Jin An, ¹¹ S. Rajesh Babu, ¹² Robert Dapkin, ¹³ Mahesh Gaudin, ¹⁴ Sam Hui, ¹⁵ Tian Hong, ¹⁶ Chiu Hsiangping, ¹⁷ Chaitanya Bhatnagar, ¹⁸ Seung-Woo Jeong, ¹⁹ Guillaume Juhel, ²⁰ Ali Karim, ²¹ Katerina Kyriakidou, ²² Kuan-Chun Lee, ²³ Bo-Chia Lin, ²⁴ Ben Li, ²⁵ Farida Murti, ²⁶ Vasek Niles, ²⁷ Katherine O'Connell, ²⁸ V.N. Raghaviah, ²⁹ Yenny Rajan, ³⁰ Mohammad Shabir, ³¹ Chiu-Hon Tan, ³² Maria Clare Tsuchiya, ³³ Gerald T. Ankley, ³⁴ Alistair B.A. Boxall, ³⁵ Murray A. Rudd, ³⁶ and Bryan W. Brooks ³⁷	

Brooks et al. 2013. *IEAM*; Furlley et al. 2018. *IEAM*; Van den Brink et al. 2018. *Environ Toxicol Chem*; Fairbrother et al. 2019. *Environ Toxicol Chem*; Gaw et al. 2019. *IEAM*; Leung et al. 2019. *Environ Toxicol Chem*; Brooks et al. 2026. In press. *Environ Toxicol Chem*

11

Why Horizon Scanning?

Horizon Scanning in Environmental Science, Engineering, and Health

Bryan W. Brooks^{1*}, Gerald T. Ankley², Alistair B. A. Boxall³, Murray A. Rudd⁴

As Ravetz (2006) himself later clarified, post-normal science is fundamentally a diagnostic framing: it describes the epistemic conditions under which knowledge is produced when facts are uncertain, values disputed, stakes high, and decisions urgent. Transdisciplinarity and stakeholder co-production are among the methodological responses that such conditions warrant. They are neither equivalent to post-normal science nor sufficient to constitute it. The bottom-up, tripartite, and crossdisciplinarity process used by the Global Horizon Scanning Project was explicitly designed to identify contested information gaps and research priorities across regions, exemplifying the practices that post-normal science calls for.



Brooks et al. 2013. *IEAM*; Furlley et al. 2018. *IEAM*; Van den Brink et al. 2018. *Environ Toxicol Chem*; Fairbrother et al. 2019. *Environ Toxicol Chem*; Gaw et al. 2019. *IEAM*; Leung et al. 2019. *Environ Toxicol Chem*; Brooks et al. 2026. In press. *Environ Toxicol Chem*

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A Triple Planetary Crisis...

Climate Change

Biodiversity Loss

Pollution

Uncertainty

13

Impacts from Disasters are Increasing around the World

What is the Sendai Framework for Disaster Risk Reduction?

The Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) was the first major agreement of the post-2015 development agenda and provides Member States with concrete actions to protect development gains from the risk of disaster.

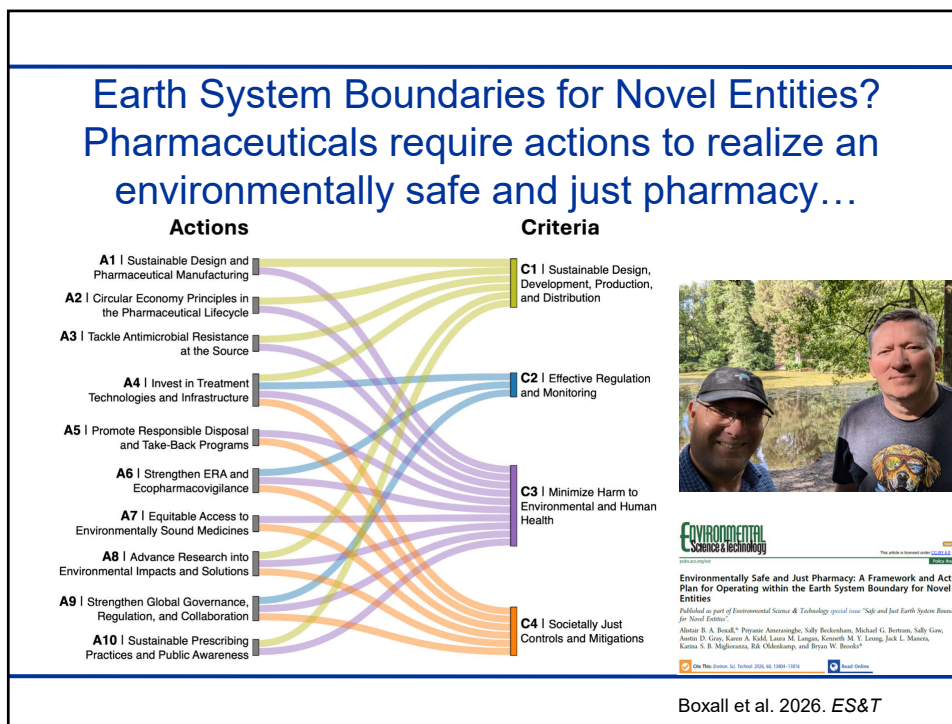
SEVEN TARGETS TO ACHIEVE BY 2030

- SUBSTANTIALLY REDUCE**
 - A. Global disaster mortality
 - B. Number of affected people
 - C. Economic loss in relation to GDP
 - D. Damage to critical infrastructure and services disruption
- SUBSTANTIALLY INCREASE**
 - E. Number of countries with national and local DRR strategies by 2020
 - F. International cooperation to developing countries
 - G. Availability and access to early warning systems and DRR information

DISASTER RESILIENCE SCORECARD FOR CITIES

CHEMICALS AND WASTE MANAGEMENT ADDENDUM
Consultative Version 1.0

14

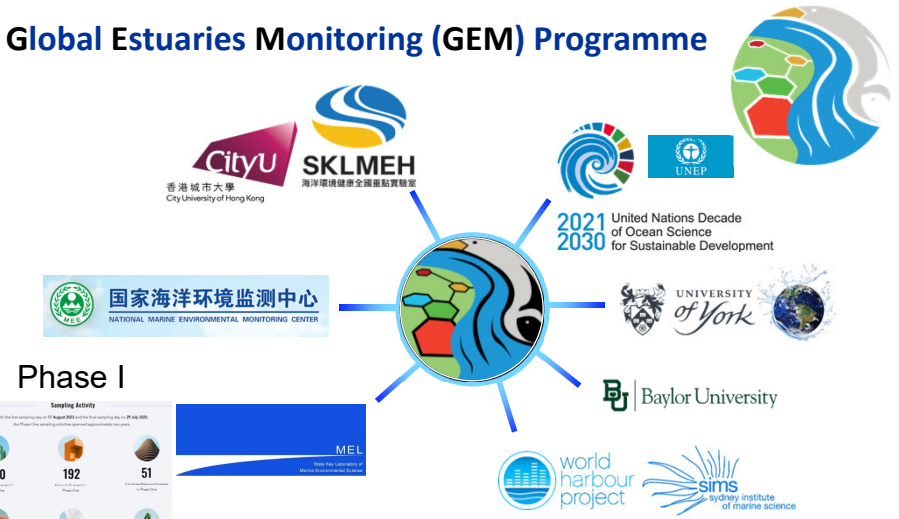


17

Where do we go from here with novel entities?

18

Global Estuaries Monitoring (GEM) Programme



The GEM Programme logo is a central circular emblem featuring a stylized estuary with a blue river flowing into a green and red landscape. Surrounding this emblem are logos of partner institutions and organizations:

- Cityu** (City University of Hong Kong)
- SKLMEH** (海洋環境健康全國重點實驗室)
- UNEP** (United Nations Environment Programme)
- United Nations Decade of Ocean Science for Sustainable Development 2021-2030**
- UNIVERSITY of York**
- Baylor University**
- world harbour project**
- sims** (sydney institute of marine science)
- 国家海洋环境监测中心** (NATIONAL MARINE ENVIRONMENTAL MONITORING CENTER)

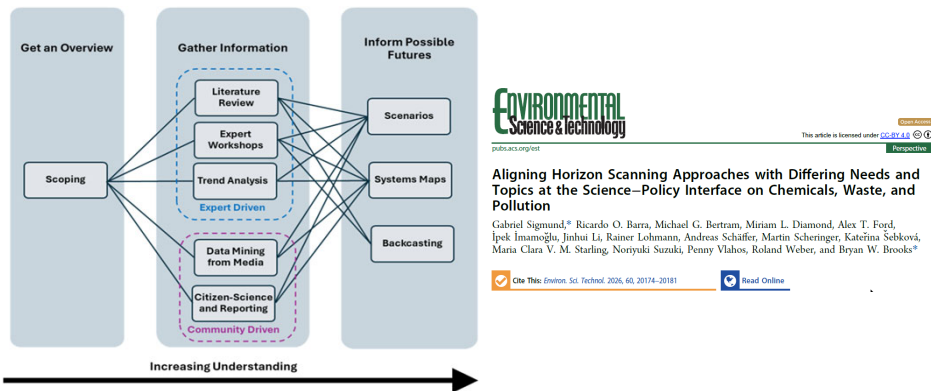
Phase I

Sampling Activity		
120	192	51
60	802	2498

www.globalestuarines.org; Adedipe et al. 2024. *Environ Int*; Luo et al. 2025. *Mar Pollut Bull*

19

We must continue to innovate, and think and work together!



The diagram illustrates a horizon scanning process flow:

- Get an Overview**: Includes **Scoping**.
- Gather Information**: Includes **Literature Review**, **Expert Workshops**, **Trend Analysis**, **Data Mining from Media**, and **Citizen-Science and Reporting**.
- Inform Possible Futures**: Includes **Scenarios**, **Systems Maps**, and **Backcasting**.

Arrows indicate the flow from Scoping to the information gathering phase, and then to the future informing phase. A dashed box labeled "Expert Driven" encompasses Literature Review, Expert Workshops, and Trend Analysis. A dashed box labeled "Community Driven" encompasses Data Mining from Media and Citizen-Science and Reporting. A large arrow at the bottom points right, labeled "Increasing Understanding".

Environmental Science & Technology
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Aligning Horizon Scanning Approaches with Differing Needs and Topics at the Science–Policy Interface on Chemicals, Waste, and Pollution

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