



Chapter 7

7. Afterword

Next Steps

The *Report on the Environment* represents a commitment by EPA to continually improve the quality and quantity of information available to understand the condition of human health and the environment and how they are changing over time. The results of these improvements will be communicated to the public via regular updates of the ROE. Specific plans for updating the report include:

- **EPA's 2008 ROE:** Revised editions of this report will be produced at a frequency that will provide input to the Agency's strategic planning process. New editions will reflect revisions or additions to the ROE questions, updates and revisions of the indicators in this report, addition of new indicators, and revisions to the "Introduction" and "Discussion" sections that accompany each question.
- **EPA's 2008 ROE: Highlights of National Trends:** This document, which communicates key information from the ROE to the interested public, will be updated periodically.
- **Electronic version of the ROE (<http://www.epa.gov/roe>):** EPA will present the ROE and ROE Highlights in electronic form on the Internet so people can navigate and query the ROE content. This "e-ROE" will be updated on an ongoing basis to enable users to obtain indicator revisions as soon as they are available.

To strengthen its ability to answer the ROE questions, the Agency will work to overcome some of the important challenges identified by public comments and by EPA's Science Advisory Board in its review of the 2008 ROE.

Challenges

Throughout this report, EPA uses indicators to answer what it believes are among the most important questions about the environment and human health. For many of these questions, the answers are incomplete. Three important challenges affect EPA's ability to answer these questions:

- Synthesizing and integrating information from multiple indicators to obtain a coherent understanding of their interrelationships, as relevant to the ROE questions.
- Filling gaps and reducing limitations in the 2008 ROE indicators.
- Addressing emerging issues that suggest potential new areas of concern for which indicators are not yet available.

All three areas offer opportunities for improvement in future editions of this report.

Synthesis and Integration

Synthesizing and integrating information across multiple indicators is a major challenge for several reasons:

- There currently are no “meta-indicators” that can provide an integrated, comprehensive measure of trends in human health or the environment to answer any of the ROE questions. Instead, the available indicators provide in-depth coverage of particular aspects of the environment or health that are relevant to answer the questions.
- Differences in the spatial and temporal coverage of indicator data make it difficult to compare trends among indicators.
- In many cases, it is not clear whether a trend in one ROE indicator is directly linked to trends in other, potentially related ROE indicators.

These types of challenges preclude EPA from being able, at present, to fully respond to the individual ROE questions or to make an integrated or “bottom line” statement in response to any of the questions. EPA will strive to address these challenges in future reports by working to fill gaps and reduce indicator limitations, as described below.

Indicator Gaps and Limitations

Each ROE question focuses on a set of interrelated environmental issues (described in the “Introduction” to the question) about which there is a good scientific understanding. In general, there are ROE indicators that describe status and trends relating to some but not all of these issues. The “Discussion” section for each question describes the limitations in the current indicators and their underlying data, as well as gaps where no appropriate indicators are available to answer important

parts of the questions. EPA is working to strategically analyze gaps and limitations in order to identify priorities for developing additional indicators and improving existing indicators.

This work will:

- Expand EPA's ability to present indicators and supporting data at variable geographic scales. This will likely involve scaling National Indicators in a way that recognizes important natural boundaries in air, land, and water, while at the same time presenting the data in a way that is meaningful and useful to EPA's Regions and other stakeholders, and developing a strategy for the incorporation of many more regional and sub-regional indicators consistent with the hierarchical framework described above in the “Synthesis and Integration” section.
- Strengthen existing indicators, both by resolving their limitations and by incorporating statistical analysis in order to quantify the uncertainty in current status and trends.
- Identify what indicators are most needed to answer the ROE questions, taking into consideration new or emerging technologies and research needs to support future development of these indicators.
- Utilize improved research, science, and technology to develop new indicators.
- Work with the scientific community to ensure that the information reported continues to meet EPA's high standards for science. EPA's Science Advisory Board has recommended that EPA revisit the indicator criteria to achieve a better balance between inclusiveness and sound science.

Partnerships with federal, state, and non-governmental organizations to support indicator development and improvement through coordinated research, monitoring, and data sharing will be critical to fulfilling this commitment.

Emerging Issues

In this report, “emerging issues” are issues whose potential to affect human health and the environment is not well understood. Emerging issues pose different challenges to EPA's ability to answer the ROE questions than do indicator gaps and limitations. For example, many emerging issues have only recently been described in the scientific literature and popular press. Therefore, the current state of scientific understanding makes it unclear whether indicators are needed, and if so, how they should be constructed and tracked. Areas where issues potentially relevant to the ROE questions are emerging include:

- **New technologies, contaminants, or environmental effects potentially related to such contaminants.** Examples include brominated flame retardants,^{1,2} residues of pharmaceuticals and personal care products,^{3,4,5} air pollutants

¹ Rayne, S., M.G. Ikononou, and B. Antcliffe. 2003. Rapidly increasing polybrominated diphenyl ether concentrations in the Columbia River system from 1992 to 2000. *Environ. Sci. Technol.* 37(13):2847-2854.

² Birnbaum, L.S., and D.F. Staskal. 2004. Brominated flame retardants: Cause for concern? *Environ. Health Perspect.* 112(1):9-17.

³ Doughton, C.G., and T.A. Ternes. 1999. Pharmaceuticals and personal care products in the environment: Agents of subtle change? *Environ. Health Perspect.* 107(Suppl 6):907-944. <<http://www.epa.gov/ppcp/pdf/errata.pdf>>

⁴ Koplin, D.W., E.T. Furlong, M.T. Meyer, E.M. Thurman, S.D. Zaugg, L.B. Barber, and H.T. Buxton. 2002. Pharmaceuticals, hormones, and other organic wastewater contaminants in U.S. streams, 1999-2000: A national reconnaissance. *Environ. Sci. Technol.* 36:1202-1211. <<http://pubs.acs.org/journals/esthag/36/i06/pdf/es011055j.pdf>>

⁵ Lindsey, M.E., M.T. Meyer, and E.M. Thurman. 2001. Analysis of trace levels of sulfonamide and tetracycline antimicrobials in groundwater and surface water using solid-phase extraction and liquid chromatography/mass spectrometry. *Anal. Chem.* 73(19):4640-4646.



related to the use of alternative fuels (e.g., biodiesel);⁶ new chemicals and new uses for existing chemicals;⁷ wastes that contain multiple materials that are challenging to separate, particularly for recycling and reuse;⁸ the growing field of nanotechnology and the potential release of engineered nanomaterials (e.g., nanoparticles) to the environment;⁹ and diseases and conditions for which there is emerging evidence that exposure to environmental contaminants may be a risk factor (see Section 5.4.3).

- **Issues for which the inherent complexity of the interactions between pollutants, environmental media, and ecological systems makes it unclear what should be measured.** Examples include (1) interactions between changing climate and feedback mechanisms and the effects of

a wide range of pollutants on human health, water resources, ecosystems, coastal areas, and other valued resources,^{10,11,12,13} including the distribution and occurrence of harmful algal blooms or other pathogens;¹⁴ and (2) loss of genetic diversity, which may result in the loss of an entire species if that species becomes less able to adapt to changing conditions.¹⁵

These examples are neither definitive nor prioritized, but offered simply to illustrate the types of challenges that lie ahead.

⁶ Morris, R.E., A.K. Pollack, G.E. Mansell, C. Lindhjem, Y. Jia, and G. Wilson. 2003. Impact of biodiesel fuels on air quality and human health. National Renewable Energy Laboratory. NREL/SR-540-33793. <<http://www.nrel.gov/docs/fy03osti/33793.pdf>>

⁷ U.S. Department of Energy. 2000. Energy and environmental profile of the U.S. chemical industry. Report prepared by Energetics Incorporated. Columbia, MD. <<http://www.eere.energy.gov/industry/chemicals/>>

⁸ U.S. Environmental Protection Agency. 2001. Electronics: A new opportunity for waste prevention, reuse, and recycling. EPA/530/F-01/006. <http://www.epa.gov/epaoswer/osw/elec_fs.pdf>

⁹ Oberdörster, G., E. Oberdörster, and J. Oberdörster. 2005. Nanotoxicology: An emerging discipline evolving from studies of ultrafine particles. *Environ. Health. Perspect.* 113:823-839.

¹⁰ Foley, J. 2005. Atmospheric science: Tipping points in the tundra. *Science* 310(5,748):627-628.

¹¹ Milkov, A.V. 2004. Global estimates of hydrate-bound gas in marine sediments: How much is really out there? *Earth Sci. Rev.* 66(3-4):183-197.

¹² Faeth, P., and S. Greenhalgh. 2000. A climate and environmental strategy for U.S. agriculture. WRI Issue Brief, World Resources Institute, Washington, DC, November 2000.

¹³ Harrison, J., and P. Matson. 2003. Patterns and controls of nitrous oxide emissions from waters draining a subtropical agricultural valley. *Global Biogeochem. Cycles* 17(3):1080.

¹⁴ Daniels, N.A., and A. Shafaie. 2000. A review of pathogenic *Vibrio* infections for clinicians. *Infect. Med.* 17(10):665-685. <http://www.issc.org/client_resources/Education/PathogenicVibrioInfections.pdf>

¹⁵ Bagley, M.J., S.E. Franson, S.A. Christ, E.R. Waits, and G.P. Toth. 2003. Genetic diversity as an indicator of ecosystem condition and sustainability: Utility for regional assessments of stream condition in the eastern United States. U.S. Environmental Protection Agency. EPA/600/R-03/056.