

Developing a “Red Book” for Cumulative Impacts

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Goals for Project

- An ad hoc Committee established by NASEM will:
 1. Explore the state-of-the-science of cumulative impact assessment
 2. Develop a consensus report with recommendations that will further define, refine, and advance the practice of cumulative impact assessment

Outline

- EPA's organizational structure
- Office of Research and Development
- Cumulative impacts
 - Policy drivers
 - Science drivers
- Work in ORD
- Charge to the Committee
- In and out of scope
- Activities around the Agency
- Distinctive characteristics of cumulative impact assessment
- Resources



Follow the
Science



Follow the Law



Advance Justice
and Equity



Be Transparent



EPA Mission: To protect human health and the environment

EPA Activities

Mission: Protect human health and the environment

To accomplish this, EPA:

- Implements environmental laws by writing and enforcing regulations
- Gives grants to state environmental programs, non-profits, educational institutions and others
- Implements voluntary programs
- Studies environmental issues
- Teaches people about the environment



EPA Headquarters in Washington, DC

EPA: Organization

Administrator

Office of Air and
Radiation

Office of the Chief
Financial Officer

Office of Chemical
Safety and Pollution
Prevention

Office of
Enforcement and
Compliance
Assurance

Office of
Environmental
Justice and External
Civil Rights

Office of Inspector
General

Office of General
Counsel

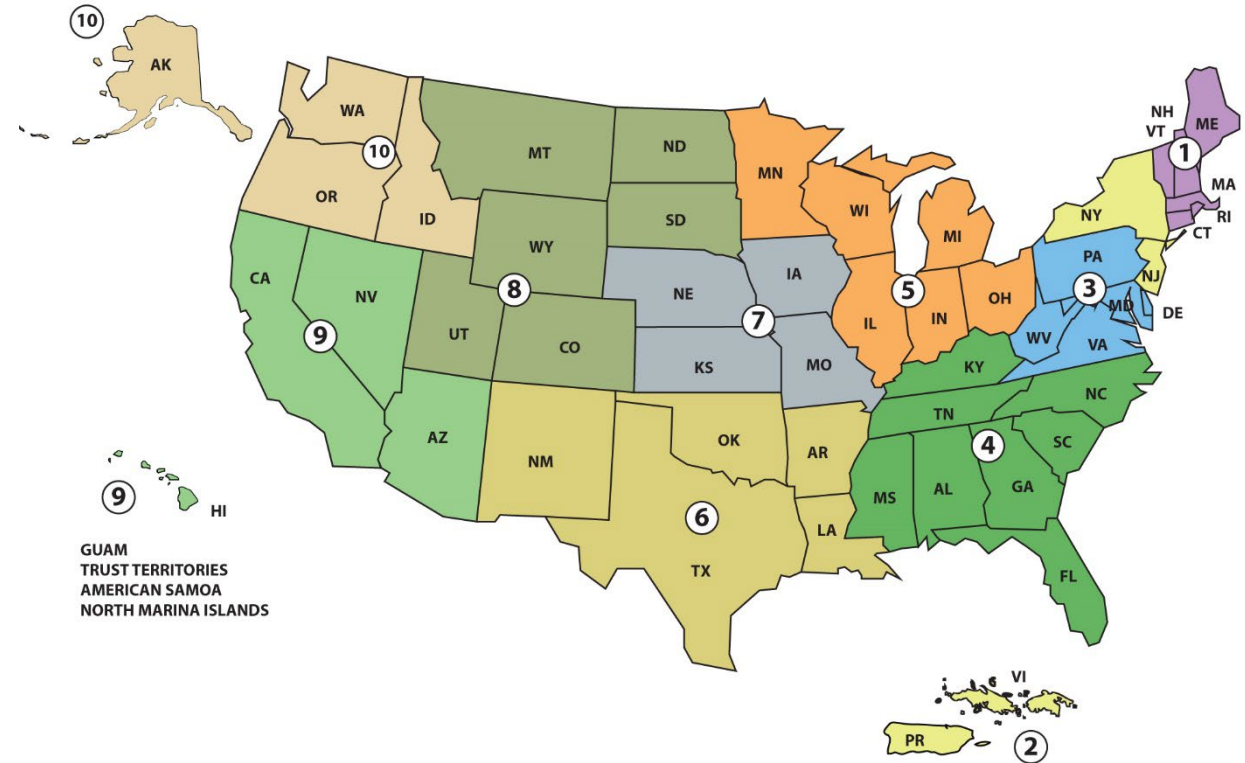
Office of
International and
Tribal Affairs

Office of Land and
Emergency
Management

Office of Mission
Support

Office of Research
and Development

Office of Water



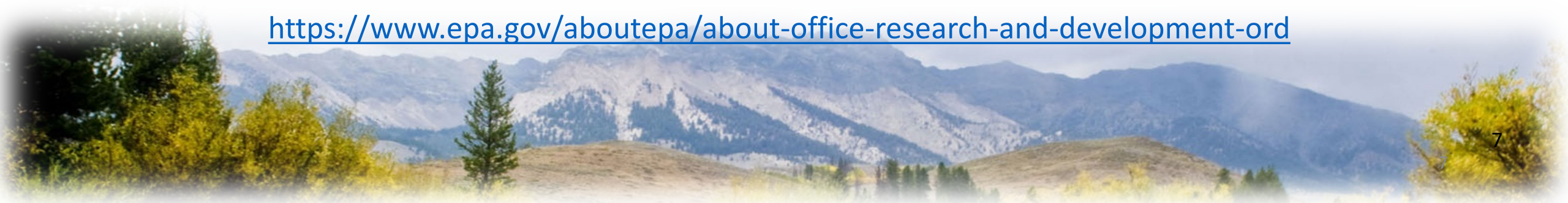
10 Regional Offices

EPA's Office of Research and Development

ORD is the research arm of EPA and provides the scientific foundation for EPA to execute its mandate to protect human health and the environment.

1. **Innovative and anticipatory research** program addressing a range of EPA and regional needs to identify and solve longer term environmental challenges
2. Research to support Agency priorities and to assist states, Tribes, and communities with addressing **environmental challenges**
3. Technical support to **respond to environmental crises and needs**, large and small

<https://www.epa.gov/aboutepa/about-office-research-and-development-ord>



Science to Support EPA's Mission

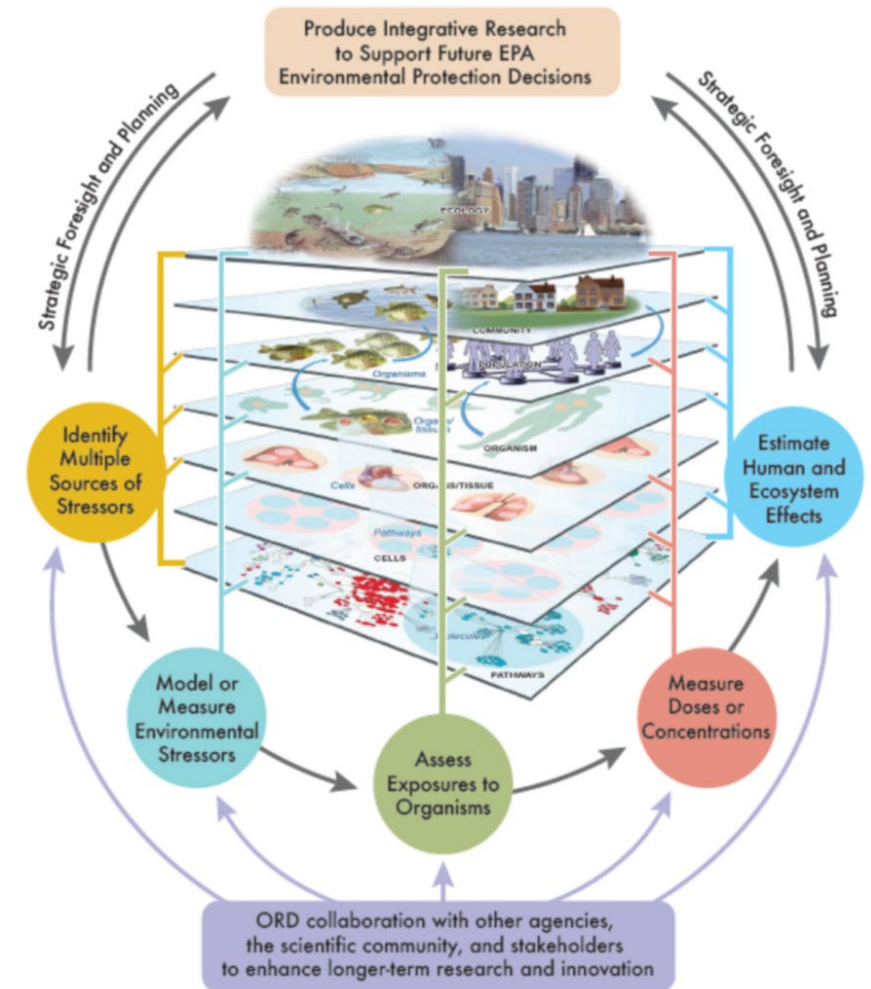
ORD's leading-edge research informs Agency decisions and supports the emerging needs of EPA stakeholders, including state, tribal, and community partners.



One Environment One Health

ORD research spans the entire spectrum of public health and environmental protection

- Identify and quantify sources of pollution and stress as well as the impacts of pollution on humans and ecosystems
- Study social, ecological, and human health aspects of environmental challenges
- Encompass everything, from the molecular level to the population, and community scale
- Span all time scales – past, present, and future
- Conduct research in specific locations and across the entire country



Cumulative Impacts & Equity/Environmental Justice



Equity/Environmental Justice: PRIORITY of the Biden Administration

- President Biden signed four Executive Orders:
 - EO 13985: Advancing Racial Equity and Support for Underserved Communities Through the Federal Government
 - EO 14008: Tackling the Climate Crisis at Home and Abroad
 - EO 14091: Further Advancing Racial Equity and Support for Underserved Communities Through the Federal Government
 - EO 14096: Revitalizing Our Nation's Commitment to Environmental Justice for All
- EPA Administrator Regan issued an Agency-wide directive to better serve historically marginalized communities using cumulative impact assessment.

[https://www.epa.gov/healthresearch/cumulative-impacts-research;](https://www.epa.gov/healthresearch/cumulative-impacts-research)

[https://www.epa.gov/planandbudget/strategicplan;](https://www.epa.gov/planandbudget/strategicplan)

[https://www.epa.gov/environmentaljustice/equity-action-plan;](https://www.epa.gov/environmentaljustice/equity-action-plan)

<https://www.epa.gov/environmentaljustice>

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Disproportionate Impacts

- Past, present, and future exposures
- Some communities are more impacted than others
- Illustrative examples:
 - Proximity to point sources (e.g., dumps, Superfund sites, Brownfields, industrial sources) ([Cannon 2024](#); [Kramar et al., 2018](#); [Stretesky and Hogan 2014](#); [Maranville et al., 2009](#); [Krieg and Faber 2004](#))
 - Traffic related issues (e.g., proximity to roadways, vehicle volume) ([Fuller and Brugge 2020](#); [Pratt et al., 2015](#); [Katz 2015](#); [Houston et al., 2004](#))
 - Community design and land use
 - Access to green/blue spaces, recreational amenities
 - Healthy food sources, quantity/quality of water
 - Access to health care
 - [Hendricks and Van Zandt 2021](#); [Dannenberg et al., 2003](#); [Hutch et al., 2011](#); [Dahmann et al., 2010](#)
- Adversely impacting health, well-being, and quality of life outcomes

What are Cumulative Impacts?



Tulve et al., 2024

Cumulative Impacts: *the totality of exposures to combinations of chemical and non-chemical stressors and their effects on health, well-being, and quality of life outcomes.*

Cumulative Impact Assessment: *a process of evaluating both quantitative and qualitative data representing cumulative impacts to inform a decision.*

<https://www.epa.gov/healthresearch/cumulative-impacts-research#Cumulative%20Impacts%20Report>

Why focus on Cumulative Impacts?

Goal: Incorporate exposure and response differences to stressors to better understand health, well-being, and quality of life outcomes

- Why?
 - Health disparities are linked to combinations of stressors in the environment, as compared to the general population
- Examples of Key Factors to Consider
 - Inequalities in exposures to both chemical and non-chemical stressors
 - Inherent characteristics influence the biological response from exposures to stressors
 - Added community stressors

Importance of Non-Chemical Stressors

Social Determinants of Health



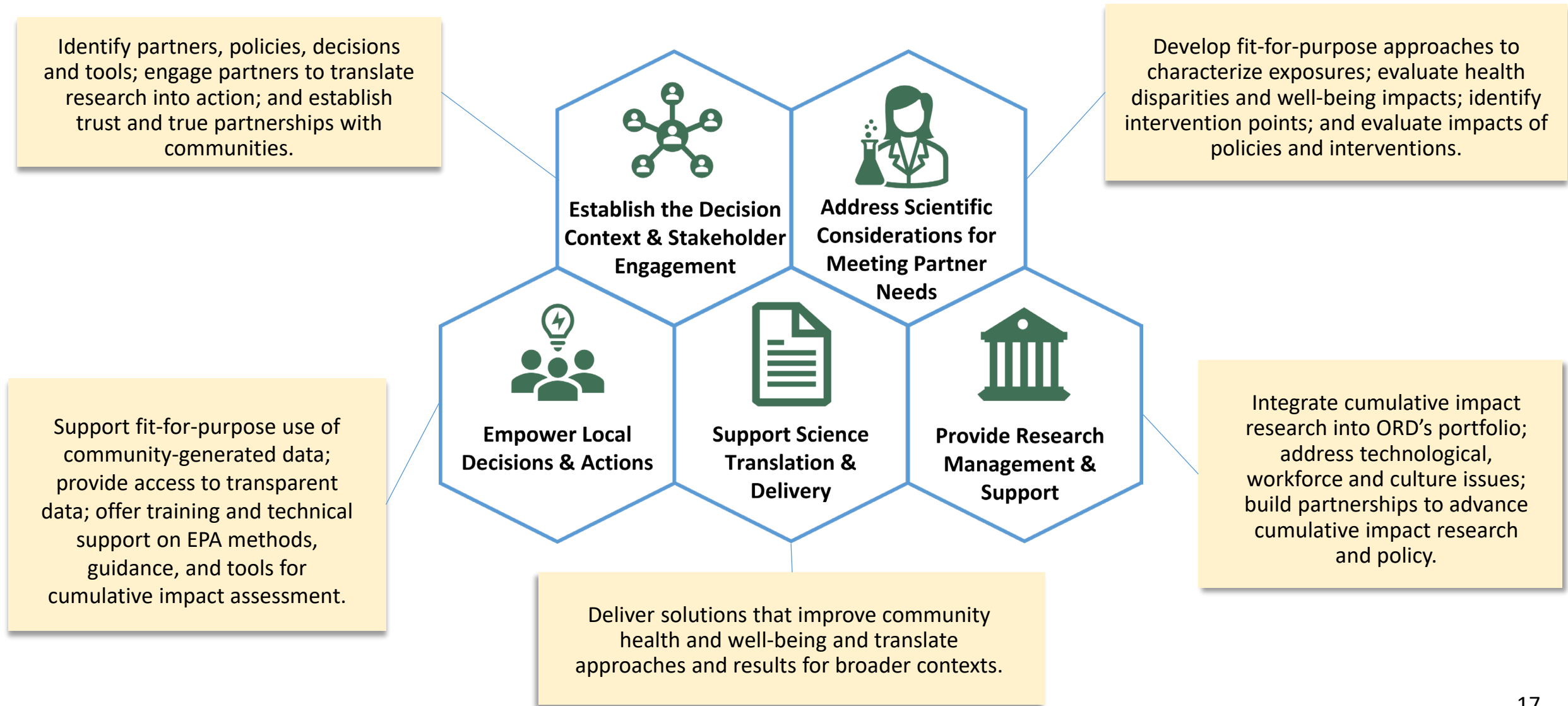
ORD Cumulative Impacts Research



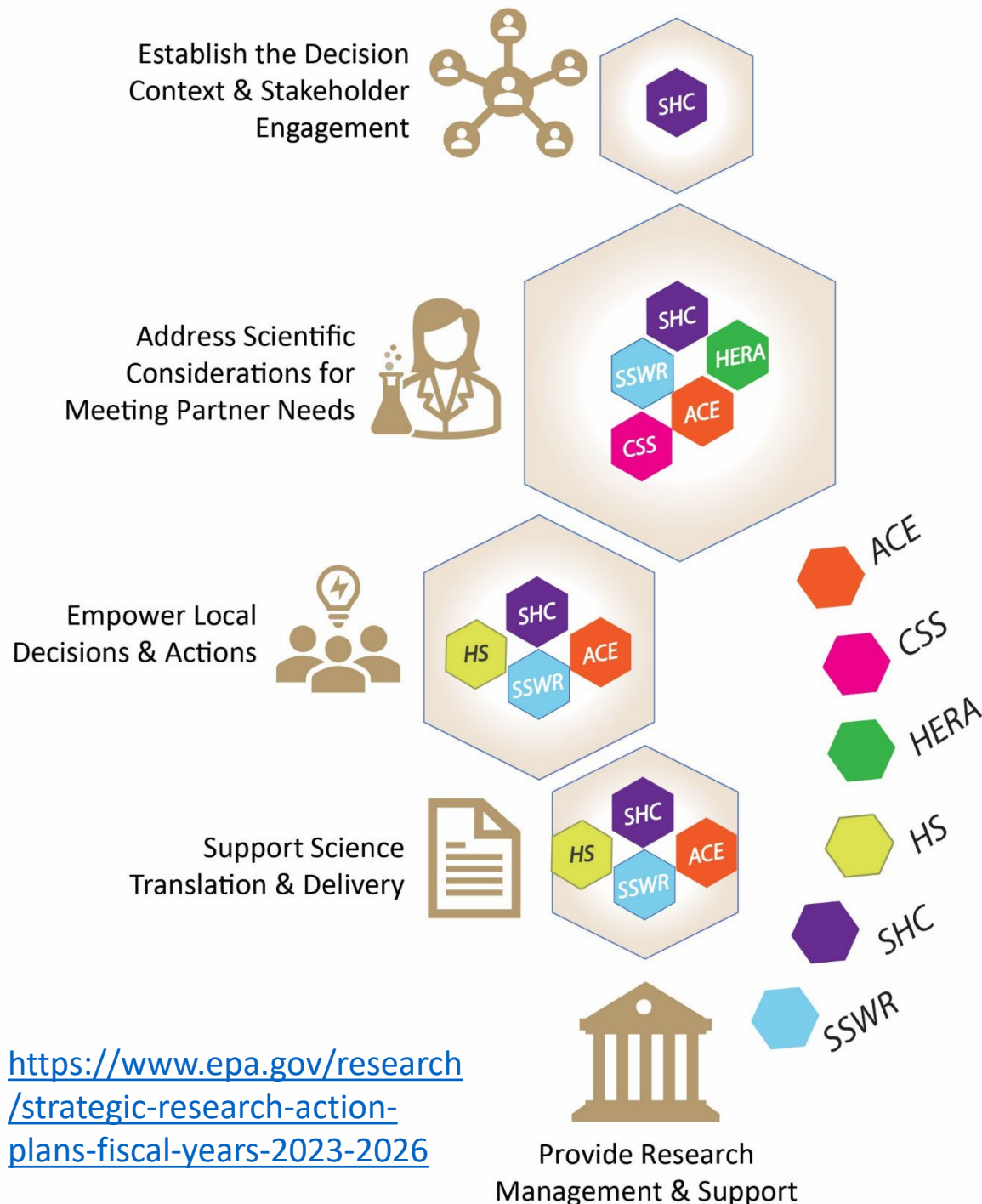
ORD recently published a report framing its research on cumulative impacts

- Recommendations are already informing actions within ORD to advance the state of the science.
- Input was critical to developing these recommendations.
 - Listening sessions with 65 Tribes, 62 state agencies, 35 local agencies, and 9 national associations.
 - Workshop with EPA Programs and Regions and community member panels.
 - Science Advisory Board consultation.

ORD's Approach to Cumulative Impacts Research



ORD's Cumulative Impacts Research (Examples)



<https://www.epa.gov/research/strategic-research-action-plans-fiscal-years-2023-2026>

Vulnerabilities and Exposure

Characterize sources, exposures, and vulnerabilities to chemical stressors in the air, water, and land; non-chemical stressors, such as access to food sources, safety, greenspace; and a changing climate may exacerbate the total burden experienced by communities.

Characterize Health and Ecosystem Impacts

Understand health and ecosystem effects from exposures to multiple chemical and non-chemical stressors.

Mitigation Options and Solutions

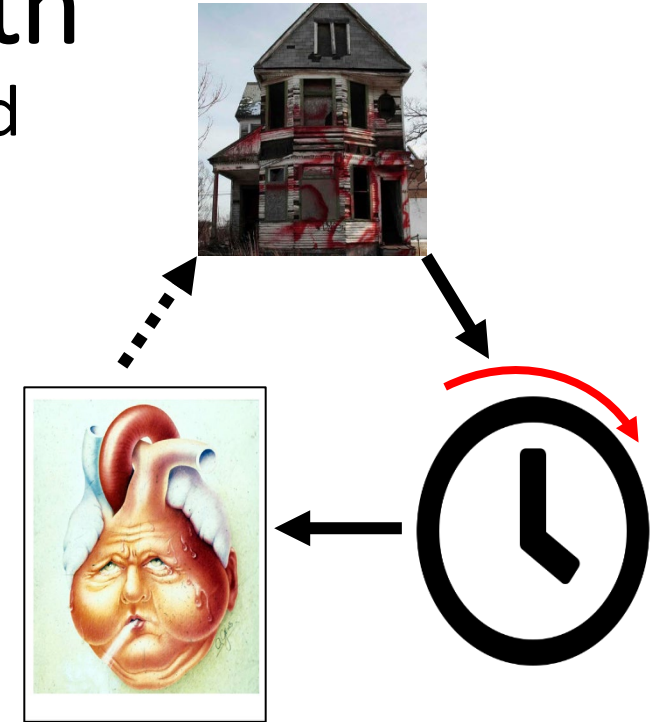
Identify and implement actions to improve community health and well-being and evaluate such actions. This includes research related to community capacity, reducing pollution, and improving benefits from nature.

Resources to Support Decisions

Develop tools, models, and datasets ranging from site-specific to national scale that can be used by EPA and communities to identify, characterize, and solve environmental problems where they are most acute, in and with communities that are most at risk and least resilient.

Neighborhood Disadvantage, Aging, and Environmental Health

- Issue: Understanding how stressors found in disadvantaged neighborhoods impact future environmental health risks
- Description: This project examines how neighborhood stressors accelerate aging in an urban, primarily Black population, based on novel epigenetic biomarkers of aging and mortality risk associated neighborhood characteristics.
- Results & Impact: **We demonstrated that neighborhood exposure to EJ-correlated factors such as poor streets, abandoned cars, and graffiti accelerated aging and mortality risks in an urban, Black population. This acceleration was offset by positive community factors such as greenspace.**

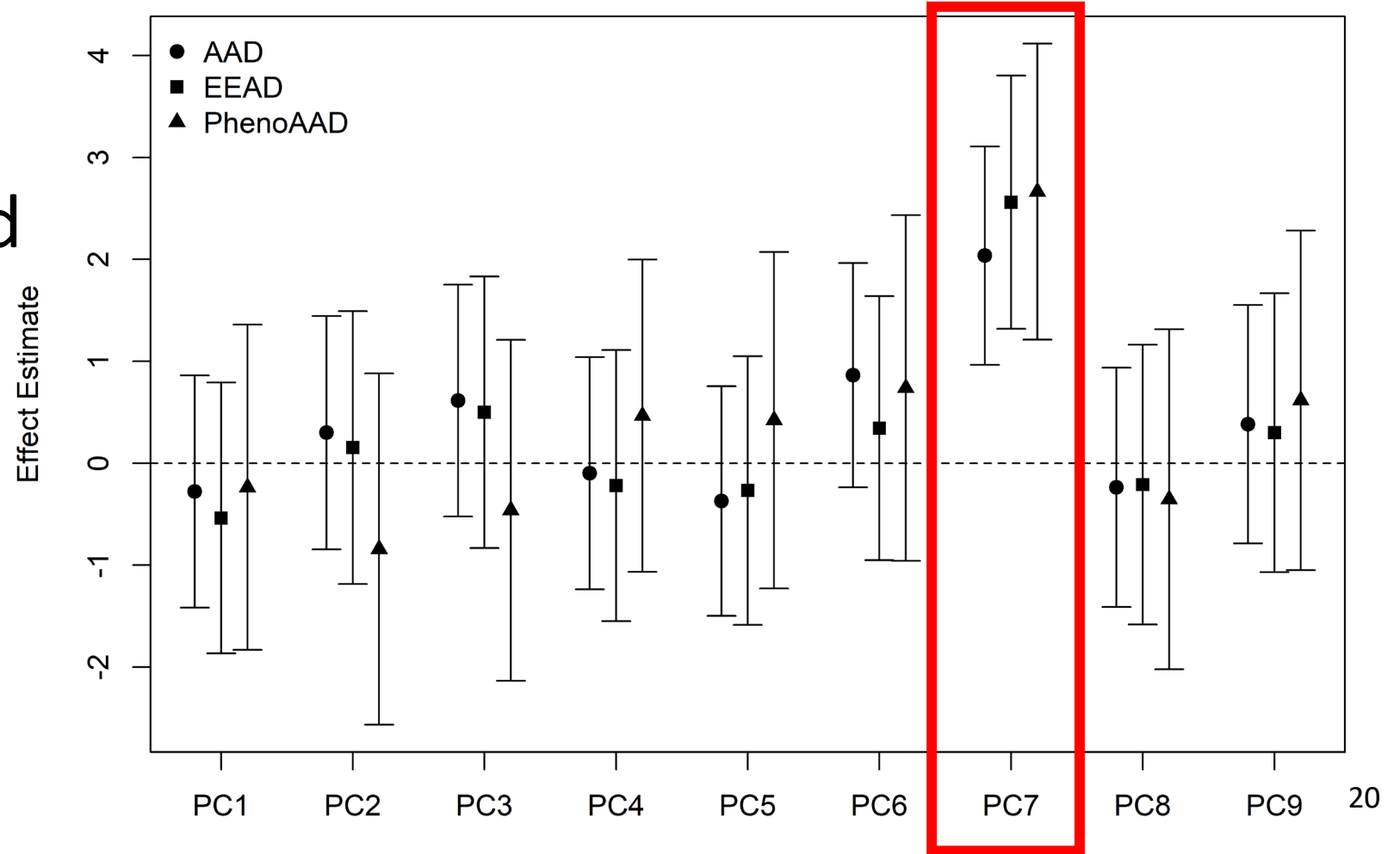


Ward-Caviness et al., 2020a;
Ward-Caviness et al., 2020b;
Martin et al., 2021

Neighborhood Disadvantage, Aging, and Environmental Health

Neighborhood Quality PCs & Epigenetic Aging

Neighborhood built environment is significantly associated with epigenetic aging biomarkers



Neighborhood Disadvantage, Aging, and Environmental Health

Can also see beneficial
effects of the
environment within this
study as greenspace
exerts a protective effect

[Ward-Caviness et al., 2020b](#)

PhenoAAD & PC7

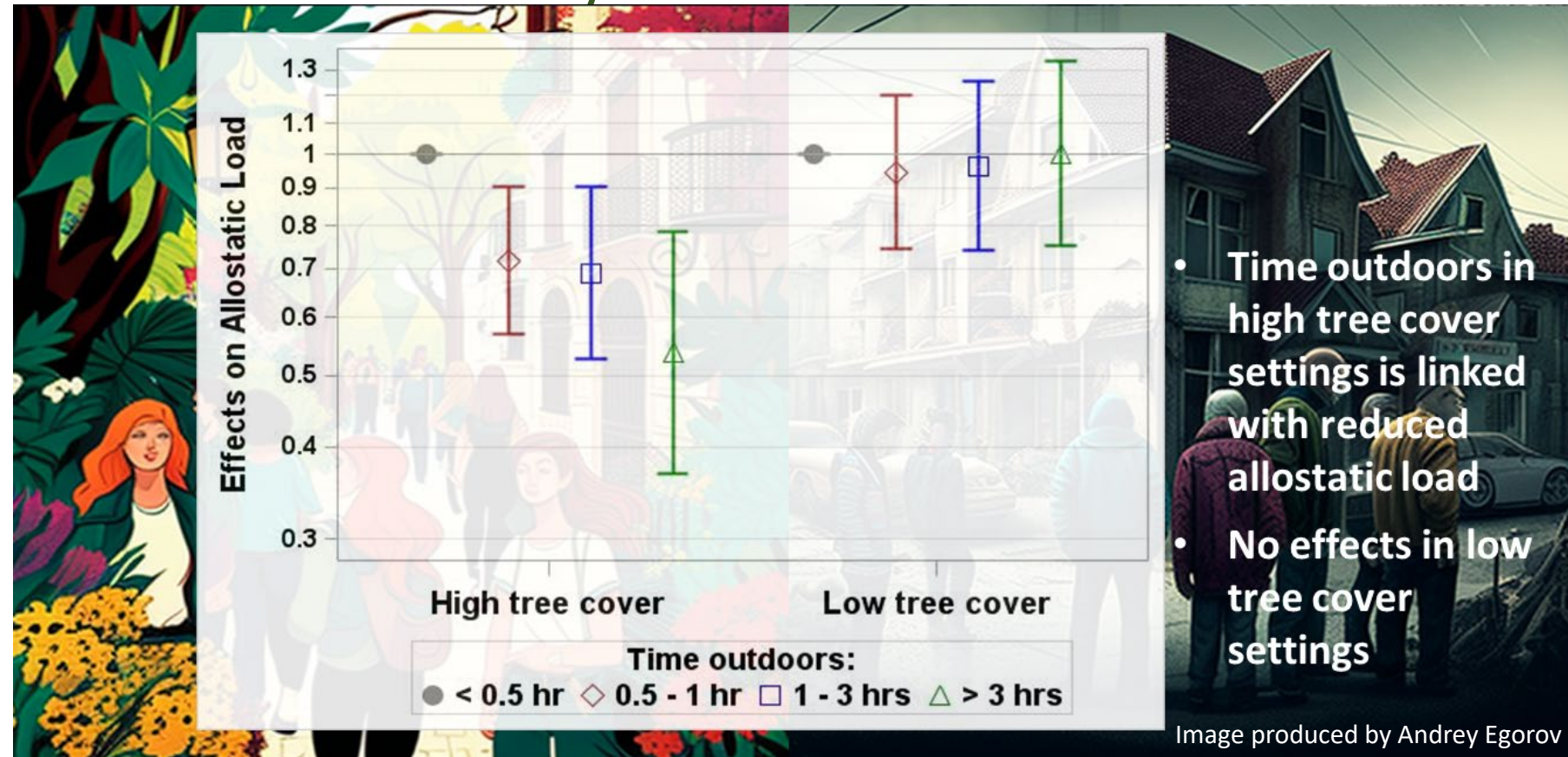


Residential Environment and Health

Residential ENvironment, Allostatic Load, and Diseases (RENALDI) study

- Cumulative effects of residential environment and behavior on sub-clinical measures of health
- Allostatic load – composite measure based on 37 biomarkers of immune, neuroendocrine, cardiovascular, and metabolic systems

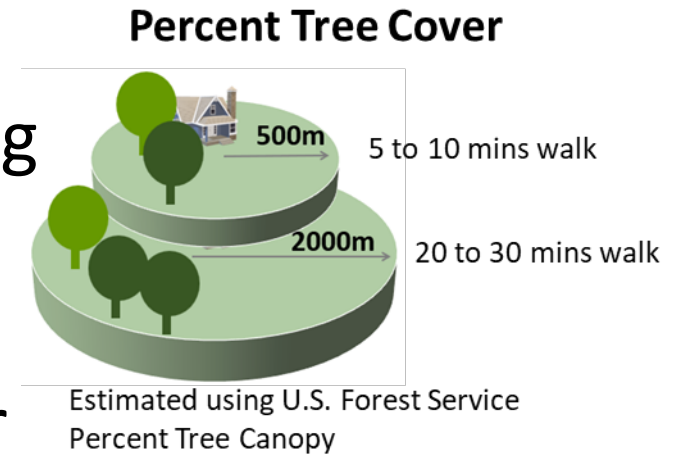
Effects of daily time outdoors on allostatic load



Generalized Additive Models adjusted for age, sex, ethnicity, education, chronic infections, problems with sleeping, daily screen time, exercising, calendar month of interview and two-dimensional spline of coordinates.

Greenspace and Well-Being

- Redlined neighborhoods had on average **20% less tree cover** compared to non-redlined neighborhoods
- Tree cover was associated with reduced odds of having depressive symptoms, with strongest associations observed in redlined neighborhoods
- Redlined neighborhoods tend to have greater risks for climate impacts such as heat exposure and air pollution which are found to associate negatively with many health outcomes, **increasing tree cover not only has the potential to reduce the prevalence of depression but also enhance overall resilience to climate impacts**



Seminal Academy Studies



Why Develop a “Red Book”?

- Provide scientific direction and expertise to the EPA
- Set the foundation for cumulative impact assessment for the scientific community
- Provide recommendations for experts throughout the scientific community

NASEM Engagement on Cumulative Impacts

- “Red book” for Cumulative Impact Assessment
- Cross-disciplinary (BEST, BECS, BPHPHP)
- Purpose
 - Advise EPA on how to further develop the scientific foundation underlying the practice of cumulative impact assessment
- Participants
 - Experts in physical, chemical, biological, environmental, data, public health, and **social** sciences.
 - Identify best practices for interaction with, and involvement of, communities.



BEST – Board on Environmental Studies and Toxicology

BECS – Board on Environmental Change and Society

BPHPHP – Board on Population Health and Public Health Practices

Focus for NASEM CI Workshops (Abbreviated)

- Identification of **key concepts** relevant to cumulative impacts such as the **exposome, toxic stress, allostasis, and vulnerability**.
- Consideration of **salutogenic or adverse perturbation** of biological pathways and functions by factors in the **built** (including chemicals and other toxicants), **social, and natural environments**.
- Consideration of how **different sources** (e.g., community input) **of evidence** on cumulative **impacts can be combined** to strengthen and extend analyses.
- Identification of **methods and approaches** for collecting and combining **quantitative and qualitative data**, and consideration of factors such as the **biological and social processes** through which the **impacts** of such exposures **accumulate**, transgenerational impacts of **exposures**, and how information can **inform environmental decision-making**.
- Identification of federal, state, and local **policy contexts** in which scientific information on cumulative impacts drive or could drive decision-making, such as how to translate local approaches to national-scale decisions and any lessons learned from successful cases of cumulative impact assessment implemented by government agencies at any level.

Charge Questions for NASEM Engagement

NASEM is assembling an *ad hoc* committee to explore the state-of-the-science of cumulative impact assessment and further define, refine, and advance the practice of cumulative impact assessment.

Example charge questions:

- How can elements of **prior risk assessment advice** and **response from communities** inform a **holistic and inclusive approach** to developing and implementing **cumulative impact assessment**?
- What **types of stressors** should be **prioritized, characterized, and considered** in combination in a cumulative impact assessment (e.g., chemical, nonchemical, and climate-related stressors)?
- How should stressors be conceptualized relative to **community assets** and **vulnerability**, and **how can environmental justice considerations be incorporated** in relation to cumulative exposures and health risks facing diverse communities and populations?
- How can **community-generated data** and **Tribal ecological knowledge (TEK)** be **incorporated** into cumulative impact assessment?
- What methods for assessing **health effects**, such as **allostatic load** (or biological aging, or toxic stress) **are most useful** for incorporating into cumulative impact assessment?
- How should **uncertainty** in cumulative impact assessments be characterized, particularly when using mixed methods?
- What are the key considerations in **characterizing and managing environmental justice** in relation **to cumulative exposures and health risks** facing diverse communities and populations?
- How can cumulative impact assessment be **adapted** to different communities, **generalized** to regional or national scale, and **remain flexible** for EPA's different programmatic needs? How cumulative impact assessments can be **integrated with environmental decision making** at the local, regional, and national level for a variety of decision contexts?

Out of Scope for Project

- Cumulative risk assessment
- Overall approach that does not consider both quantitative and qualitative data and information

In Scope for Project

- Science and art of using cumulative impact assessment as a means to address environmental injustices
- Scientific approaches, data, methods, tools, and analyses for various decision contexts
- Social and behavioral science aspects related to social determinants of health, community engagement, and approaches to identify, choose, and evaluate interventions
- Science translation to facilitate explicit inclusion of cumulative impacts in decision-making

Importance of Decision Context

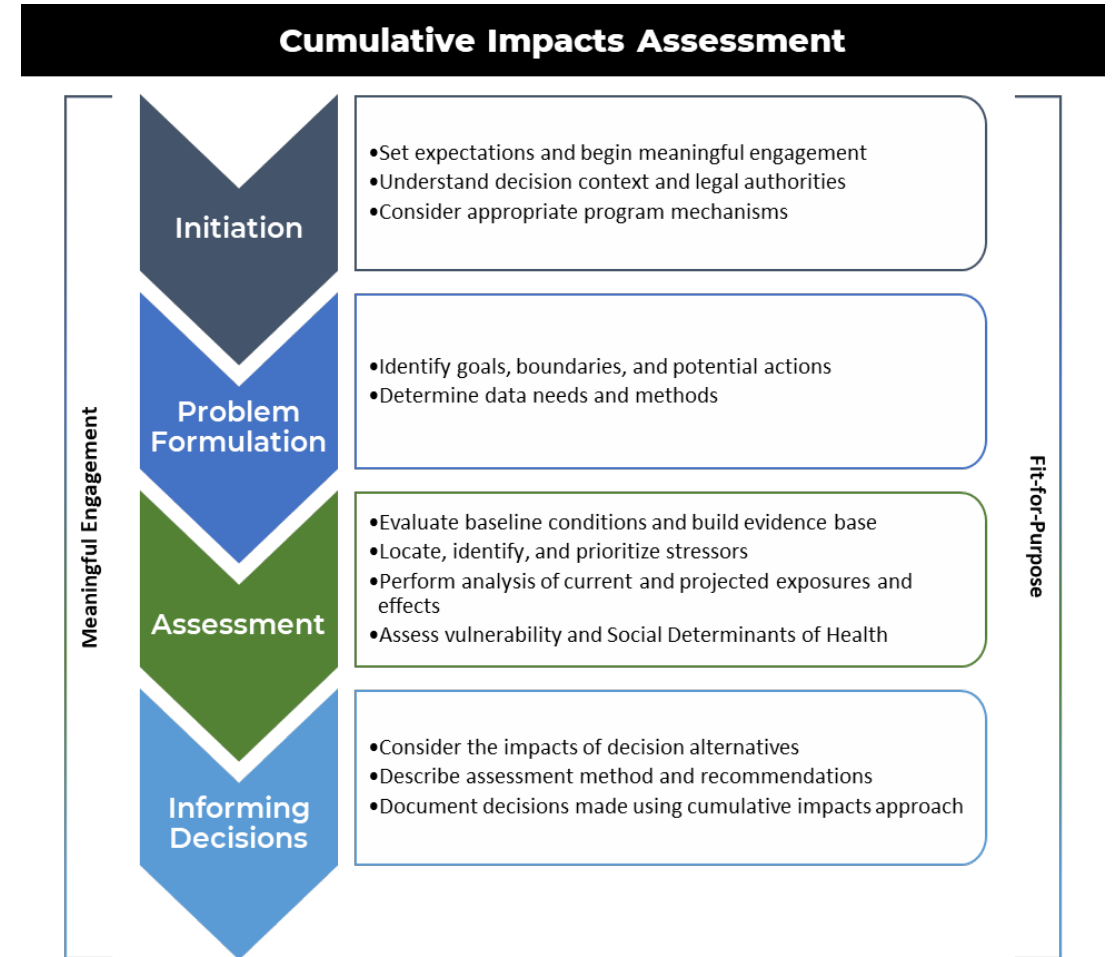
- Cumulative impact assessments should be conducted within the context of specific decisions at the federal, state, and local levels
- Establish decision context
- Types
 - Regulatory
 - Permitting
 - Equitable development
 - Compliance monitoring and enforcement activities
 - Research
- Decisions regarding interventions that improve health, well-being, and quality of life
- Not just about preventing or avoiding harm, but also about seeking salutogenic outcomes

Activities Going on Around the Agency

- Cumulative Impacts Framework
- Place-based activities (Regional)
 - [Dallas, TX cumulative impact assessment project](#)
- Legal applications
 - [EJ Legal Tools and Cumulative Impacts Addendum](#)
- Tools
 - [EJ Screen](#)
 - [EnviroAtlas](#)
- More information available on the Cumulative Impacts webpage:
<https://www.epa.gov/healthresearch/cumulative-impacts-research>

A Framework for Advancing Consideration of Cumulative Impacts

- EPA is developing a framework to advance analysis and consideration of cumulative impacts into its work.
- The framework will provide a foundation for EPA Program and Regional Offices to develop and implement approaches for considering cumulative impacts in their work, also recognizing the roles of state, Tribal, territorial, and local governments and other interested parties.
- A draft of the Framework will be published soon, including public comment.



Addressing cumulative impacts is key to EPA achieving its mission of protecting human health and the environment 33

Distinctive Characteristics of Cumulative Impact Assessment

- Characterizes existing community conditions and determines actions to improve those conditions
- Focuses on community health and well-being
- Assesses risk at community level
- Incorporates lived experiences of communities
- Considers hazards and benefits
- Exposures to non-chemical stressors are included as their own discrete factors
- Includes both quantitative and qualitative data
- Example assessment methodologies: allostatic load, biomonitoring, health impact assessment, global burden of disease, modeling approaches
- Endpoints that define poor health status, reduced lifespan, and reduced capacity to fully realize the health, well-being, and quality of life of members of a community
- Fit for purpose, parsimonious, timely, responsive to community concerns and needs
- Informs selection of interventions to improve health, well-being, and quality of life

Wrap Up

- High priority
- High expectations
- The Agency is doing a lot now to advance and apply cumulative impact assessment
- This NASEM project supports long-term advancement and application of cumulative impact assessment

ADDITIONAL SLIDES

Participatory Science and Science Translation



Volunteer Water
Monitoring



Smoke Sense App



CyanoScope



Equipment Loan
Programs



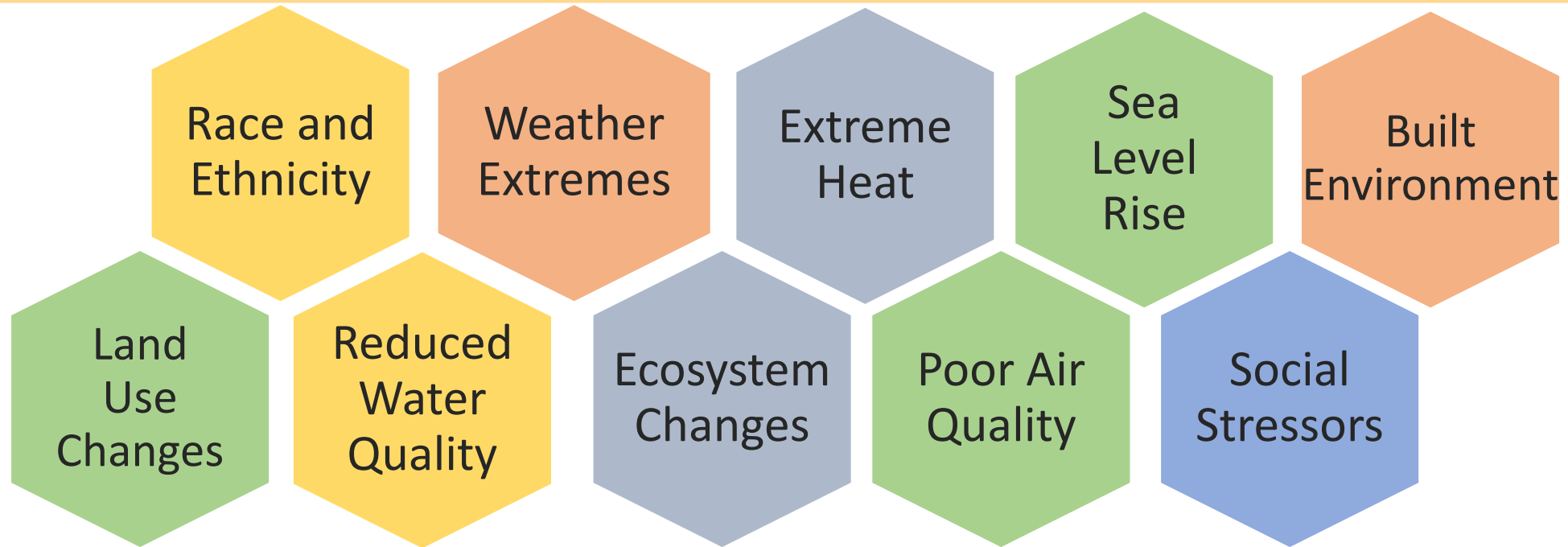
Project LEO



Air Sensor Toolbox

Climate Change Is An Administration Priority

Impacts of climate change on health are complex, often indirect, and dependent on multiple societal and environmental factors



How can we do research that supports adaptation planning and resilience building?

Integrating social science is key

Integrated Climate Sciences

ORD is advancing two new climate-focused initiatives, an **Interdisciplinary Climate Assessment Program (ICAP)** and a **Regional Climate Assistance Network (RCAN)**.

ICAP

- Quantitative assessments of climate damages.
- Assessments of the costs of climate change and the benefits of national, state, and local actions to control GHGs.
- Input to metrics, e.g., the Social Cost of Carbon.

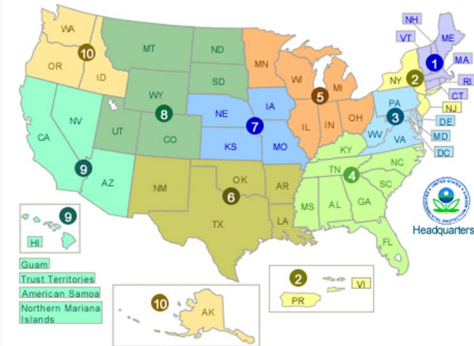
Integration and Evaluation

of products, processes,
and outcomes to inform
both ICAP and RCAN.



RCAN

- Regionally-relevant assessments, technical support, capacity building for adaptation planning and resilience.
- Special focus on frontline communities most vulnerable to climate impacts.
- Technical support for mitigation actions.



Community-Engaged Research

ORD, with EPA Region 2, is establishing a [Community-Engaged Research Collaborative for Learning and Excellence](#) (CERCLE) in Edison, New Jersey.

CERCLE will:

- **Build long-lasting, trusting relationships** with overburdened communities
- Connect community challenges with EPA science
- **Support joint research studies** in and with communities, helping translate results into community actions
- Conduct **STEM engagements** with community youth;
- **Strengthen EPA capacity** to do community-based participatory research and develop procedures and protocols to support the process end-to-end
- **Share results widely** to build the scientific community's capacity to work directly with communities

