

Research Directions and Challenges for EPA's Air Climate and Energy Research Program

Tim Watkins

Deputy National Program Director
Office of Research and Development

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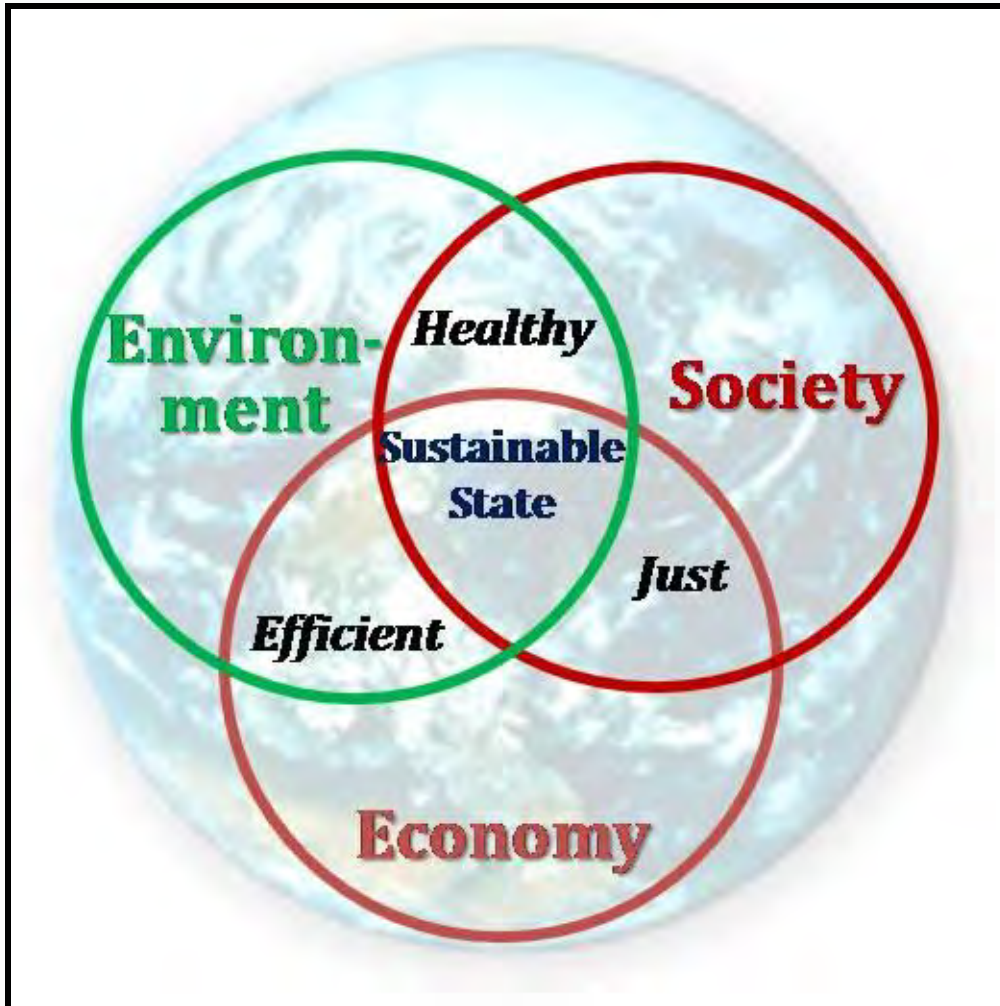


New Directions for EPA's Office of Research and Development



- *Sustainability* is the “true north” that will guide our research and innovation priorities
- We will create broad sustainability research programs based on *systems thinking*
- We will engage with our *stakeholders* to develop *sustainable solutions* relevant to their needs
- We will engage in *integrated, transdisciplinary* research throughout our portfolio
- We will be a *catalyst* for progress in sustainability in the U.S. and around the world

Sustainability & Systems Thinking



Sustainability: to create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations.

NEPA [1969] and Executive Order 3514 [2009]

Sustainability and the US EPA

(National Research Council 2011)

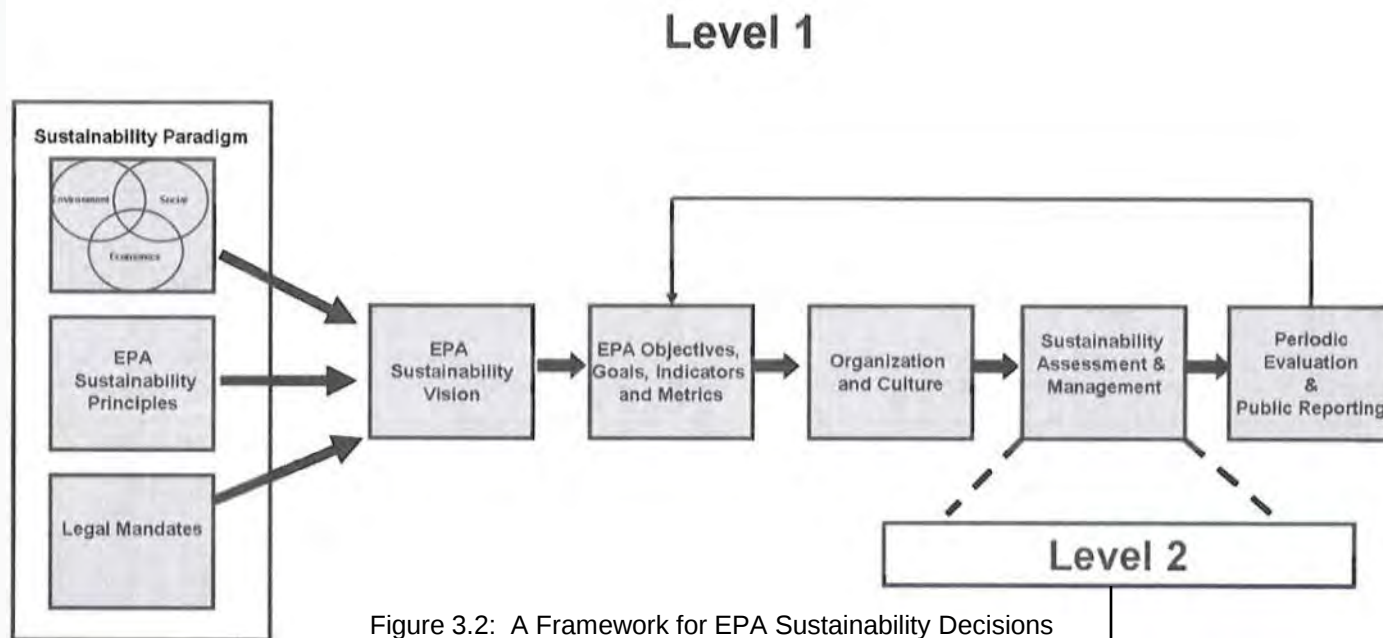
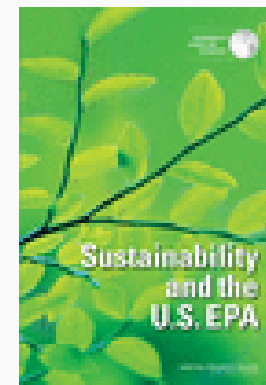


Figure 3.2: A Framework for EPA Sustainability Decisions
(NRC 2011)



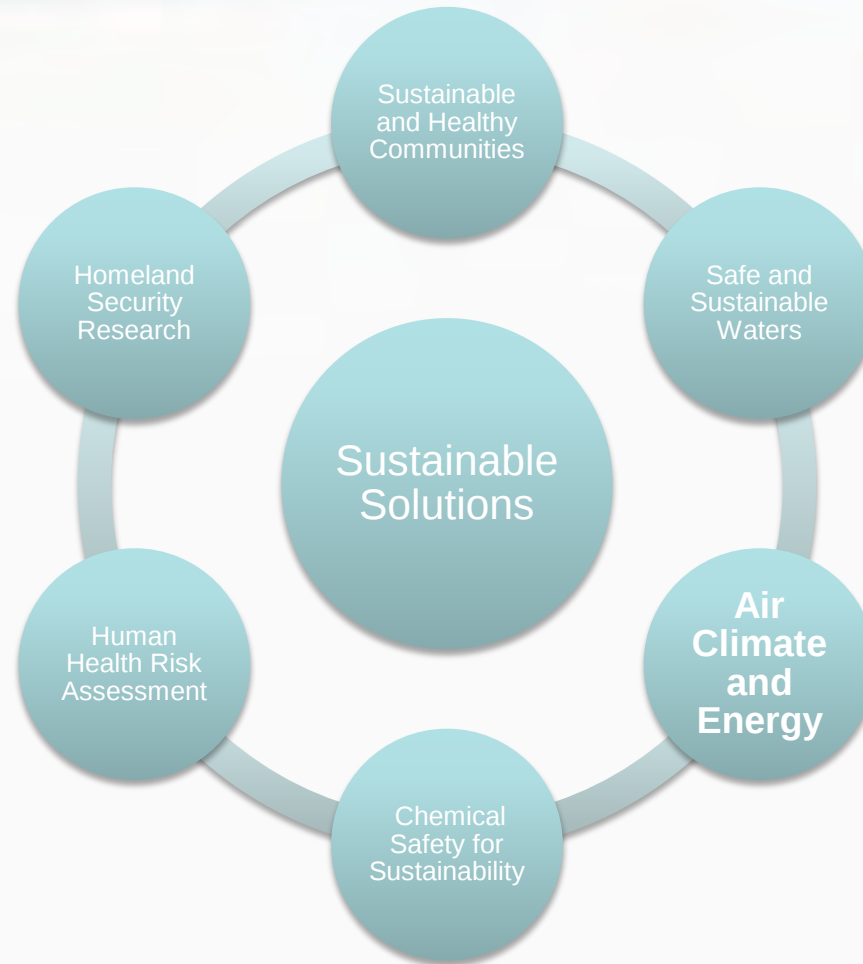
Sustainability Tools include:

- Risk Assessment
- Life-Cycle Assessment
- Benefit-Cost Analysis
- Ecosystems Services Valuation
- Integrated Assessment Modeling
- Sustainability Impact Assessment
- Environmental Justice Tools
- Present Condition and Future Scenario Tools

Sustainability Assessment & Management (Level 2) Includes:

- Sustainability Screening Evaluation
- Stakeholder Engagement
- Sustainability Tools
- Tradeoffs/Synergy Analysis
- Decision Implementation
- Evaluation

Building Sustainability and Systems Thinking into EPA Research



Earth Systems



Air

Ambient Air Quality
Pollutant Deposition

Climate

Changes in:
Temperature · Extremes
Precipitation · Sea Level

Exposures to and Effects on:

Ecosystems · Watersheds

Human Health and Communities

Responses

Mitigation
Prevention
Adaptation

Social Factors

Population · Public Health · Economy
Technology · Transportation · Behavior
Water/Food Supply · Land Use Change

Responses

Mitigation
Prevention
Adaptation

Energy

Emissions of Air
Pollutants
and Other Environmental
Stressors

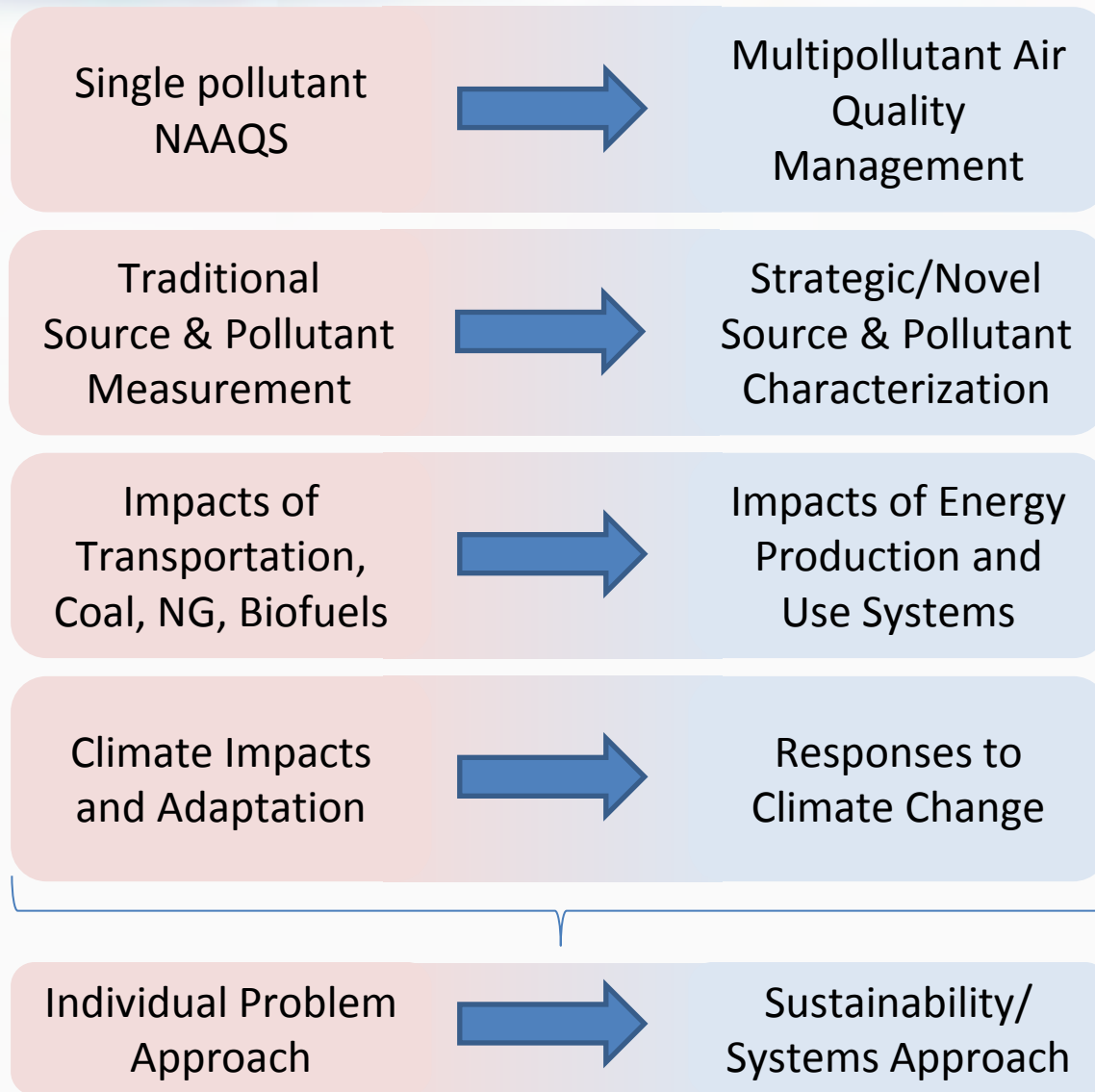
Human Systems

Key Issues for ACE



- The multipollutant nature of air pollution
- The impacts of climate change and the development and evaluation of sustainable adaptation and mitigation options
- The human health and environmental impacts of current and future energy alternatives
- The expanding and contracting scales of environmental problems that range from global to local
- The social, behavioral, and economic factors that influence the effectiveness of air quality and climate policies

Evolution of ACE Research



ACE Research Themes





Assess Impacts

Assess human and ecosystem exposures and effects associated with air pollutants and climate change at individual, community, regional, and global scales.

Objectives:

- o Inform the review of the NAAQS
- o Assess multipollutant exposures and effects
- o Innovative approaches to assess exposures and effects of pollutants in the atmosphere
- o Identify characteristics of populations and ecosystems susceptible to exposure to air pollutants and climate change





Prevent and Reduce Emissions

Provide data & tools to develop and evaluate approaches to prevent and reduce emissions of pollutants to the atmosphere, particularly environmentally sustainable, cost effective, and innovative multipollutant and sector-based approaches



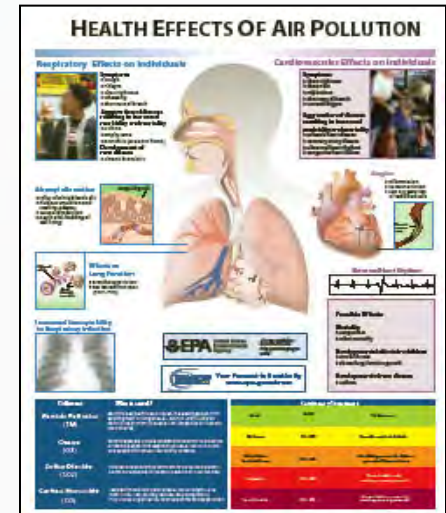
Objectives:

- o Support the management of air pollution problems at different scales of time and space
- o Support implementation of NAAQS
- o Innovative technologies to support AQ management strategies
- o Evaluate pollution reduction and prevention solutions
- o Develop methods and data for life-cycle analyses of alternative pollution reduction and energy options



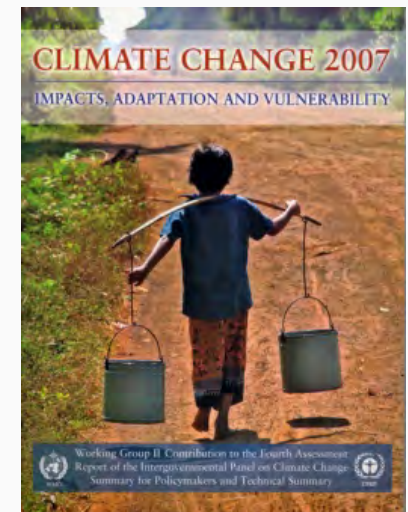
Respond to Changes in Climate & Air Quality

Provide human exposure and environmental modeling, monitoring, metrics and information needed by individuals, communities, and governmental agencies to adapt to the impacts of climate change and make informed public health decisions regarding air quality



Objectives:

- o Evaluate alternative adaptation strategies
- o Devise innovative methods to inform individual- and community-level adaptation to climate change and decision making for air quality
- o Evaluate social, behavioral, and economic factors that influence adaptation strategies for climate change and decision making for air quality



ACE Themes and Research Topics



ACE Framework

Theme 1:
Assess Impacts

Theme 2:
Prevent / Reduce
Emissions

Theme 3:
Respond to
Changes



Research Topics for ACE Partner Needs

Air Quality Climate
Interactions

Energy and Biomass

Emissions and
Measurements

Climate Mitigation/
Adaptation

Modeling / Decision
Support Tools

NAAQS and
Multipollutant

Sustainable Solutions

Proposed ACE Research Projects



ACE Topic Area	ACE Project
Air Quality and Climate Interactions	Characterization of Relationships between Air Quality, Climate Change, and Adverse Health Effects
	Net Climate and Air Quality Impacts
Energy and Biomass	Protecting Human and Ecosystem Health in an Evolving Energy Landscape
	Managing the Impacts of Emerging Bioenergy Pathways
Emission and Measurements	Methods for Measurement to Inform Policy Decisions
	Improving Emissions Inventories
	Changing the Paradigm for Air Pollution Monitoring
Mitigation and Adaptation	Vulnerable People and Ecosystems
	Climate change impacts, at national, regional, and local scales
	Developing Sustainable Climate Adaptation and Mitigation Approaches
Modeling and Decision Support Tools	Local- to Urban- to State-Scale MP Air Quality Models
	Regional- to Continental-Scale MP Air Quality Modeling
	Modeling Air Quality impacts on Pollutant Deposition and Water Quality
	Hemispheric- to Global-Scale MP Air Quality and Climate Models
	Predictive Modeling of Population Variability in Biomarkers
	One Environmental Modeling System
NAAQS and Multipollutant	Human exposure and effects of air pollutant mixtures and NAAQS pollutants
	Multipollutant exposures to understand impacts of mixtures on health effects
	Climate change/health impacts and controls related to sources and atmospheric transformations
	Near-source impacts and mitigation options
	Susceptible populations to exposures to pollutant mixtures
	Methodologies to better understand multipollutant exposures and health effects
	Atmospheric deposition tools to inform secondary NAAQS
Sustainable Solutions	Green Chemistry to Develop Alternatives for Air Toxic Chemicals
	Sustainability Metrics and Indicators across Sectors, Systems and Communities

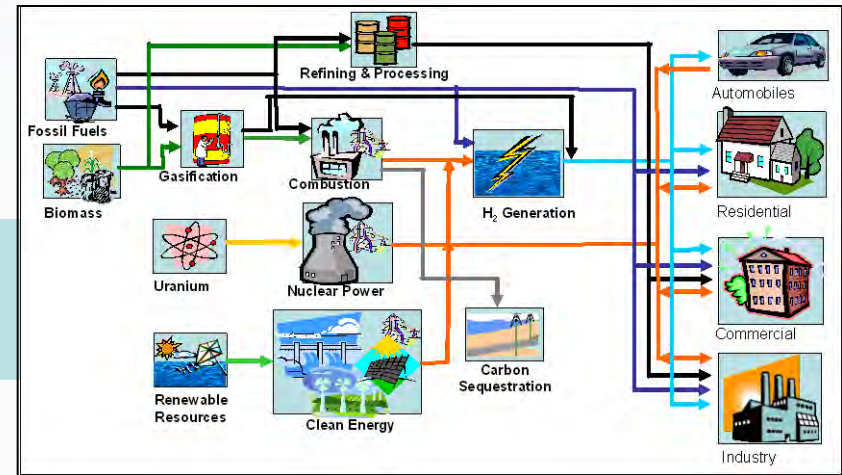
Note: Bolded Projects are potential ACE Signature Projects because they embody the strategic evolution of the ACE program towards sustainable solutions, systems analysis, innovation and integration,

Example: Systems Modeling of Environmental Impacts of Technology Change with MARKet ALlocation (MARKAL)



MARKAL Inputs:

- Future-year energy service demands
- Primary energy resource supplies
- Current & future technology characteristics
- Emissions and energy policies



- Through linear optimization MARKAL finds the least cost set of technologies

MARKAL Outputs:

- Technology penetrations for meeting industrial, residential, commercial, and transportation demands
- Fuel use by type and region
- Sectoral and system-wide emissions
- Marginal fuel and emissions reduction prices

Policy Challenges/Opportunities for ACE Research



- Multipollutant Air Management
 - Air Quality
 - Climate Change
 - Climate-Air Quality Interactions
- Sustainability/Systems Analysis
 - Incorporating sustainability concepts into decision making process
- Technology Innovation
 - Keeping up with rapid pace of innovation
 - Responding to external applications (e.g. measurements)
 - Evaluation for internal EPA use