

# Program Vision for EPA's Air, Climate, and Energy Research Program: Directions and Challenges

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- Overview of ACE program
- ACE response to 2011 SAB/BOSC comments
- Information related to ACE charge questions
  - ACE progress
    - Program development and management
    - Communication/outreach
    - Scientific contributions and products
  - Sustainability in the ACE research program
  - Balancing immediate and emerging research priorities
  - Energy research in ACE
  - Innovation in ACE
  - ACE integration with other ORD programs

# 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



## **Problem Statement:**

Protecting health and the environment from the impacts of climate change and air quality in a sustainable way are central 21st century challenges. These challenges are complicated by the interplay between air quality, the changing climate, and emerging energy options.

## **Vision:**

To provide cutting-edge scientific information and tools to support EPA's strategic goals of protecting and improving air quality and taking action on climate change in a sustainable manner.

# ACE Research Themes



## Theme 1: Assess Impacts

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



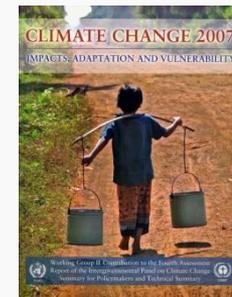
## Theme 2: Prevent and Reduce Emissions

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



## Theme 3: 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



# ACE Response to 2011 SAB/BOSC Comments



- Incorporate sustainability in the ACE program and balance related sustainability research with research to support legislative mandates and more immediate needs
  - ACE is developing and applying tools/data to support sustainability analyses
  - Working with partners
- Build a social, behavioral and decision sciences component in the ACE program
  - Initiated discussions with external scientists
  - Advertising a Post Doc position
  - Collaborations within EPA
    - Office of Policy/National Center for Environmental Economics
    - Office of Air and Radiation

# ACE Response to 2011 SAB/BOSC Comments (cont)



- Greater emphasis needed on climate mitigation (both technology and social/behavioral)
  - EPA role on developing mitigation technology is limited
  - ACE is evaluating environmental impacts and sustainability of mitigation and adaptation approaches
- Use integrated assessments, driven by particular problems at the community, regional or national levels to integrate ACE with Sustainable and Healthy Communities (SHC) and the Safe and Sustainable Water Resources (SSWR) research programs
  - Climate change and nitrogen roadmap are two good examples of ACE integration with SHC and SSWR
  - Worked with SSWR to develop FY 13 budget proposal on identifying environmental impacts of and sustainable approach for hydraulic fracturing
  - Exploring opportunities to evaluate the use of innovative air monitoring sensor technologies in community pilots
- Other comments related to changes in the Framework have been addressed in the ACE StRAP and in resulting ACE projects

# ACE Progress: Program Development and Management



- Developed research topics, projects, and tasks using the ACE StRAP as a guide
  - Identified Project Leads and Task Leads
- Refining the strategic vision for ACE “signature” projects
- Developed future plans for STAR RFAs with partner input
- Provided input an FY13 budget proposal related to air emissions from hydraulic fracturing processes
  - Overall goal to help identify sustainable approaches

# ACE Progress: Communication/Outreach



- ACE “Jamboree”
  - Held on Jan 30, 2012
  - Purpose was to provide an overview of the ACE program for our partners and obtain feedback on
    - Whether we provided a coherent picture of the ACE program
    - The direction and structure of the program
    - Refining project outputs /products
    - Identifying next steps
    - Unforeseen issues that need to be resolved
  - Partners were asked to
    - Communicate with their office management
    - Be our “advocates” among their colleagues
  - Very positive feedback from the participants

# ACE Progress: Communication/Outreach (cont)



- Ongoing communications with EPA partners
  - Bi-weekly ACE calls
    - Open to all
    - ACE “Moment of Science”
  - Monthly air and climate focused calls with key representatives
  - Identifying partner advocates for each ACE project
  - NPD meetings with senior management
    - Division Directors through Assistant Administrator
- ACE media
  - New websites
  - ACE quarterly newsletter (first issue expected in July 2012)
- Regional outreach
  - Visits to Regions 5, 8, and 9
  - Planning a visit to Region 4 (EPA lead Region for air starting in 2013)



- Selected FY11 accomplishments
  - New release of the Community Multiscale Air Quality (CMAQ) model
  - EPA contributions to NASA DISCOVER-AQ
  - Emissions testing for clean cookstoves
  - Public health and wildfires
  - Awards of new clean air research centers
  - New version of SPECIATE database
  - Supporting the National Climate Assessment
  - Results of near roadway research
  - Preliminary results from MESA-Air
  - STAR air and climate change research
    - Climate Change, Land Use, and Declining Amphibians Populations
    - California Salmon Runs and Climate Change
    - Climate and Emissions Changes on U.S. Water Quality

# ACE Progress: Scientific Contributions and Products (cont)



- **Selected FY12 products**

- Synthesis of recent research on the implications of climate change for future U.S. sulfate, nitrate, and carbonaceous aerosol concentrations, as well as total PM.
- GLIMPSE version 1.0: SLCF: black carbon, organic carbon, sulfate, ammonia; GHGs: CO<sub>2</sub>, methane, N<sub>2</sub>O; air quality health impact estimates
- Incorporation of OAQPS alternative scenarios of the future into the MARKAL energy system model and summary report of how these scenarios can be used to support Regulatory Impact Assessments
- Analysis of cookstove pollutant emissions of gases and particulate matter, including carbonaceous materials and energy efficiency, from laboratory evaluation
- Physiologically-based pharmacokinetic model for ethanol that will estimate internal doses of ethanol in rats across life stages from the oral and inhalation routes
- Method for locating and remotely assessing VOC and GHG emissions from oil and gas production operations
- Daily Ozone and Fine Particulate Surfaces for 2001-2008 archived on EPA web site
- Challenge of climate change adaptation planning, barriers to incorporating scientific information into planning and the potential value of Robust Decision Making (RDM) methods for surmounting these obstacles.
- Examining the associations of traffic-related exposure with socio-demographic characteristics in the US
- Operational evaluation of CMAQ version 5.0
- Cardiovascular effects associated with exposure of humans to ozone
- Characterization of carbonaceous aerosols emitted from outdoor wood boilers.
- Engineering-economic models capable of addressing cement and pulp and paper sectors, multipollutant, multi-market, and multi-region emission reduction policies, objectives and constraints on outdoor wood boilers
- Potential of omega-3 fatty acids to ameliorate cardiovascular effects of PM

# ACE Progress: Scientific Contributions and Products (cont)

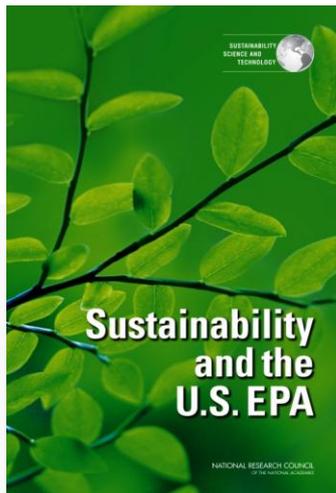
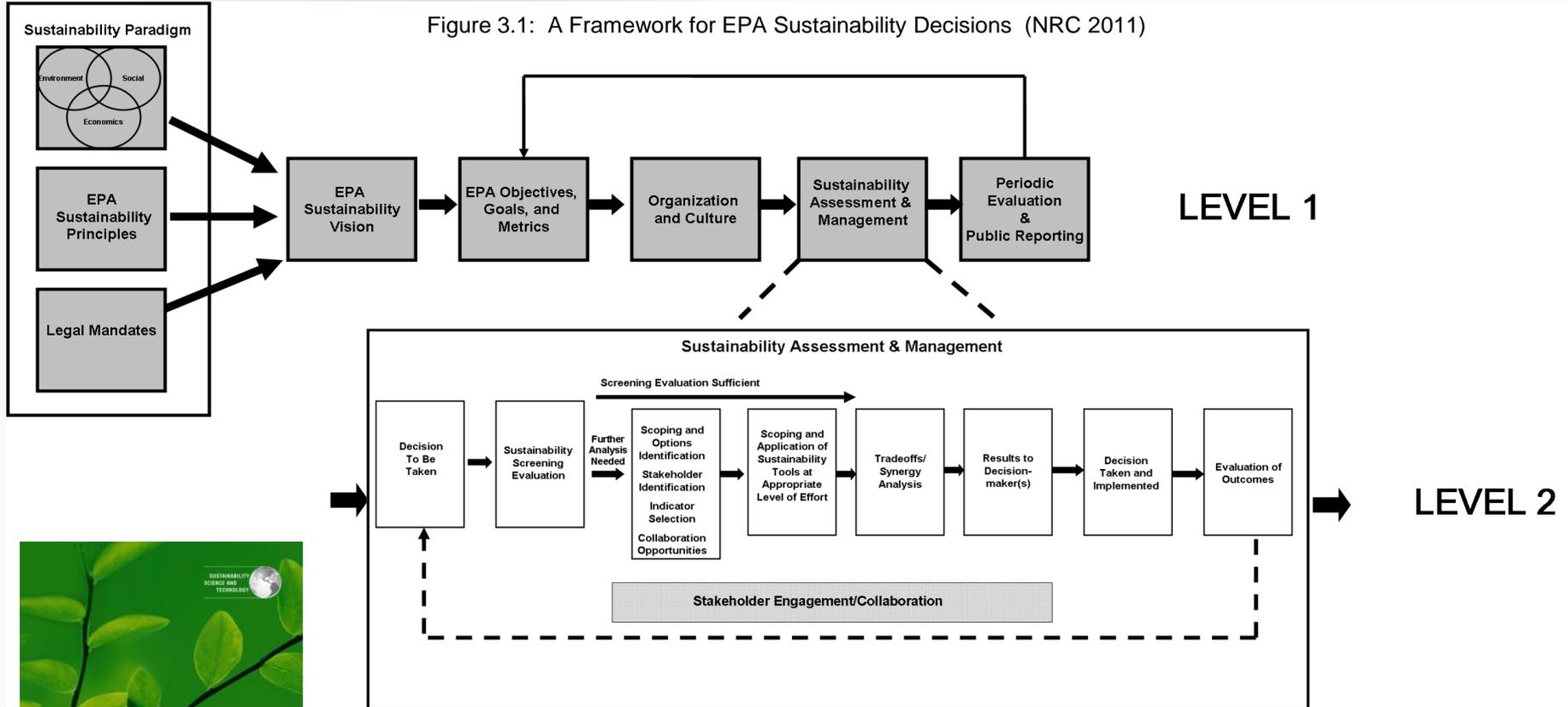


- Air pollution sensors and apps
  - Next Generation Air Monitoring (NGAM) workshops
    - Sensor Technology Developers and Stakeholders (March 2012)
    - Fenceline applications (Nov 2012)
  - Open source challenges
    - Joint challenge with HHS: “My Air, My Health”
    - Acrolein and benzene measurements
  - Sensor methods evaluation opportunity (Fall of 2012)
  - Working closely with EPA partners
    - Office of Air and Radiation (OAR)
    - Office of Enforcement and Compliance Assurance (OECA)

# Sustainability and the US EPA (National Research Council 2011)



Figure 3.1: A Framework for EPA Sustainability Decisions (NRC 2011)



# Evolving ACE Thoughts on the NRC Green Book



- NRC Level 1: Incorporating Sustainability in the EPA
  - A regulatory approach dictates what can and can not be done, while facilitating sustainable decision making requires leadership, education and tools to make more sustainable decisions.
- NRC Level 2: Developing and Applying Sustainability Assessment Tools
  - 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
- Implications for ACE
  - Develop tools to facilitate sustainability discussions and analysis across EPA and work with partners, particularly EPA Regions, to apply and evaluate these tools.

# Sustainability in ACE



Broad ACE Vision/Objective	Related ACE Research	Related NRC Sustainability Analytic Tools
<p>Evaluate interactions between air pollutants and climate forcers and identify trade-offs or synergies in climate change and air quality policies.</p>	<ul style="list-style-type: none"> <li>• Integrated air quality-climate modeling</li> <li>• Integrated air quality-climate assessments</li> <li>• Human health impacts of climate-air quality interactions</li> </ul>	<ul style="list-style-type: none"> <li>• Benefit-cost analysis</li> <li>• Futures/scenarios analysis</li> <li>• Integrated assessment models</li> </ul>
<p>Develop approaches to evaluate and assess life cycle environmental impacts and full costs of possible future energy scenarios and alternatives.</p>	<ul style="list-style-type: none"> <li>• Energy systems modeling and assessment</li> <li>• Life cycle assessment methods</li> <li>• Assessment of environmental impacts of energy technology</li> <li>• Biofuels/biomass</li> </ul>	<ul style="list-style-type: none"> <li>• Benefit-cost analysis</li> <li>• Futures/scenarios analysis</li> <li>• Integrated assessment models</li> <li>• Life-cycle assessment</li> </ul>
<p>Develop, evaluate and apply source and ambient air monitoring methods to support regulatory and research objectives and to inform community/individual level decision making.</p>	<ul style="list-style-type: none"> <li>• Changing the paradigm of air pollution monitoring - sensors/apps, satellites, data fusion</li> <li>• Methods for measuring compliance and enforcement</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental justice tools</li> </ul>

# Sustainability in ACE (cont)

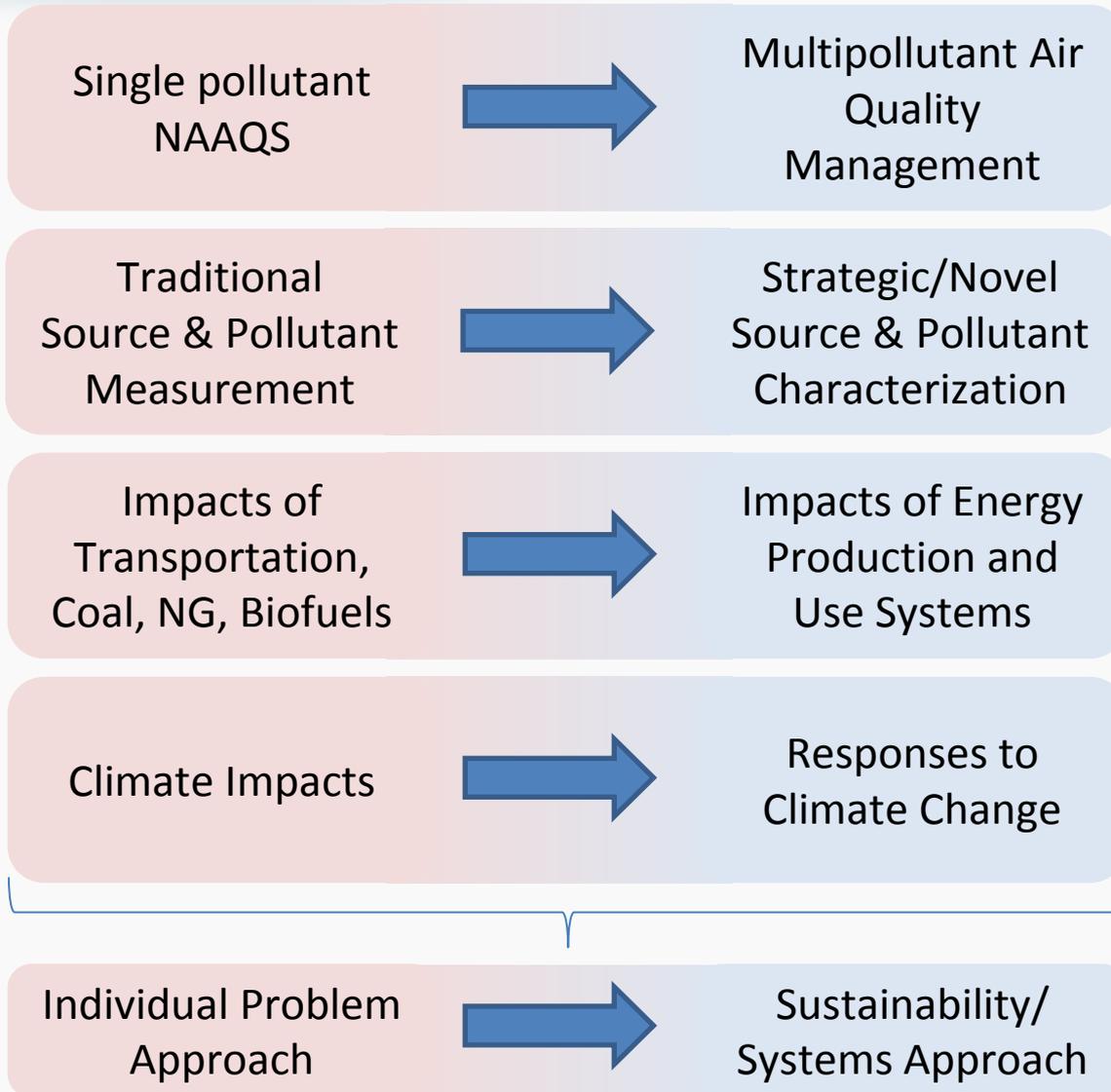


Broad ACE Vision/Objective	Related ACE Research	Related NRC Sustainability Analytic Tools
<p>Collect data and conduct systems-oriented analyses to inform the design of sustainable climate mitigation and adaptation strategies across environmental media.</p>	<ul style="list-style-type: none"> <li>• Climate scenarios</li> <li>• Vulnerability assessment</li> <li>• Integrated climate impact assessments</li> <li>• Climate adaptation tools/indicators</li> <li>• Regional adaptation case studies</li> <li>• Adaptation and mitigation interactions</li> </ul>	<ul style="list-style-type: none"> <li>• Benefit-cost analysis</li> <li>• Ecosystem service valuation</li> <li>• Environmental justice</li> <li>• Futures/scenarios analysis</li> <li>• Integrated assessment models</li> <li>• Sustainability impact assessment</li> </ul>
<p>Develop multipollutant, multimedia and multiscale models capable of supporting integrated environmental analyses.</p>	<ul style="list-style-type: none"> <li>• Local/regional/continental/global modeling</li> <li>• Integrated multimedia systems modeling</li> </ul>	<ul style="list-style-type: none"> <li>• Benefit-cost analysis</li> <li>• Environmental justice</li> <li>• Futures/scenarios analysis</li> <li>• Integrated assessment models</li> <li>• Sustainability impact assessment</li> </ul>
<p>Develop and apply approaches to assess exposures and human and ecological effects of air pollutant mixtures to support NAAQS.</p>	<ul style="list-style-type: none"> <li>• Exposure metrics</li> <li>• Near source</li> <li>• Susceptibility</li> <li>• Multipollutant health assessment approaches (MOA, 'omics, statistics)</li> <li>• Atmospheric deposition</li> <li>• Clean air centers (star)</li> </ul>	<ul style="list-style-type: none"> <li>• Benefit-cost analysis</li> <li>• Environmental justice</li> <li>• Risk assessment</li> </ul>

# Balancing Immediate Needs and Emerging Issues: The Evolution of the ACE Program



More Immediate Needs



Longer Term Issues  
Emerging and

# Balancing Immediate Needs and Emerging Issues: Emerging ACE Research Objectives



- Developing a “one-environment modeling” system
- Protecting human and ecosystem health in an evolving energy landscape
- Changing the paradigm for air pollution monitoring
- Evaluating interactions between air pollutants and climate forcers and identifying trade-offs or synergies in climate change and air quality policies.
- Developing sustainable climate adaptation and mitigation approaches
- Developing and applying approaches to assess exposures and human and ecological effects of air pollutant mixtures

# ACE Energy Related Research



- Energy production and use is closely tied to air pollution and emissions of greenhouse gases
  - Significant changes in energy sources and technologies are expected over the coming years
  - The existing system and future changes have beneficial and adverse environmental impacts
- The energy system is highly complex and connected to economic, social, and environmental systems
- EPA's challenge is to understand and mitigate the environmental impacts in ways that support social needs and economic viability
  - ORD is working with other agencies (especially DOE and USDA) and incorporating social, behavioral, and economic sciences to enable more robust evaluations of impacts and mitigation approaches

# ACE Energy Related Research: Examples



- Environmental impacts of hydraulic fracturing activities (DOE, USGS)
- Water demands of energy production (DOE, USDA)
- Greenhouse gas mitigation options database (DOE)
- Development of robust decision making processes (decision science)
- Supporting local and regional decision making on energy and environmental issues: input from local stakeholders (social and economic issues)
- Exploration of collaborative decision making methods to support stakeholders with diverse and conflicting energy/environmental objectives (decision science, social and economic issues)

# ACE Integration with Other ORD Programs



- Nitrogen roadmap
- Climate change
- Children's health/environmental justice
- Energy, particularly energy/water nexus
- Decision support tools
- Multimedia modeling
- Multipollutant approaches

# Examples of Innovation in ACE



- Multipollutant Approaches
  - Genetics/omics
  - Mode of action to identify toxicity pathways
  - Application of novel exposure estimates in health studies
- Emissions/Measurements
  - Sensor technologies for source and ambient measurements
  - Using satellite data for air quality applications
  - Emissions surrogacy approaches
- Modeling
  - Multimedia modeling systems
  - Coupled chemistry and meteorological models
  - GLIMPSE model to assess trade-offs and synergies of air quality and climate change policies
  - Virtual cardiopulmonary (CP) system

# Charge Questions



- **First Year Progress:** How are the ORD research programs progressing in the first year of implementation? Are the research activities planned for FY 13 and future years appropriate for answering the science questions in the Strategic Research Action Plan?
- **Sustainability:** How are ORD programs contributing to sustainability through their research plans and activities? What advice does the SAB and BOSC have for each research program about advancing sustainability in future research?
- **Balancing Immediate Needs and Emerging Issues:** As we consider science for the future, while budgets continue to shrink, how should ORD balance its commitments in the Strategic Research Action Plan with the need to advance science on emerging issues?
- **Energy Research in ACE:** How do we bring together research on biofuels, oil and gas measurement methods, combustion related pollutant effects and modeling/decision support tools into a coherent whole to address the environmental effects of energy production and use?
- **Integration:** Based on the presentation of five integrated topics, what advice can the SAB and BOSC provide to help ORD succeed in integrating research across the ORD programs? How can different approaches to integration help us achieve our research goals?
- **Innovation:** How can ORD's initial innovation activities be improved to ensure continued and long term benefits for EPA? Are there useful experiences and lessons from other research organizations about managing innovation? What guidance can the SAB and BOSC provide for ORD in developing metrics that would be most effective in assessing the success of our innovation efforts?

# Appendix



# ACE Topics and Projects



- Climate Impacts, Mitigation, and Adaptation
  - Vulnerable people and ecosystems
  - Climate change impacts, at national, regional and local scales
  - Characterization of relationships between air quality, climate change, and adverse health effects
  - *Sustainability, interactions, and co-benefits*
- Emissions and Measurements
  - Methods for measurement to inform policy decisions
  - Improving emissions inventories using measurements and models
  - *Changing the paradigm for air pollution monitoring*
- Sustainable Energy Evaluation
  - *Energy and the environment: protecting human and ecosystem health in an evolving energy landscape*
  - Energy from biomass: managing the impacts of emerging bioenergy pathways
- Modeling and Decision Support Tools
  - Local- to urban- to state-scale MP air quality modeling and decision support system
  - Regional- to continental-scale MP air quality modeling and decision support tools
  - *Integrated multimedia systems modeling for sustainability*
  - Hemispheric- to global-scale MP air quality and climate modeling and decision support tools
  - Predictive modeling of population variability in biomarkers
- NAAQS and Multipollutant
  - Human exposure and effects of air pollutant mixtures and NAAQS pollutants
  - Multipollutant exposures to understand impacts of mixtures on health effects
  - 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