



# ***Air Climate & Energy (ACE): Building a Foundation of Science to Support Policy and Solve Problems***

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***SAB/BOSC Breakout Group***  
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# ORD Research Programs



## Air, Climate & Energy



## Sustainable & Healthy Communities



## Homeland Security



## Chemical Safety for Sustainability



## Human Health Risk Assessment



## Safe & Sustainable Water Resources



# EPA Strategic Plan 2014-2018

([http://www2.epa.gov/sites/production/files/2014-04/documents/epa\\_strategic\\_plan\\_fy14-18.pdf](http://www2.epa.gov/sites/production/files/2014-04/documents/epa_strategic_plan_fy14-18.pdf))



## Goal 1: Addressing Climate Change and Improving Air Quality

- Conduct integrated science assessments of criteria air pollutants and provide new data and approaches for improving these assessments
- Develop credible models and tools to inform sustainable policies, decisions, and responses to a changing climate by EPA national and regional offices, state, tribal, and local governments, and others
- Conduct research to change the paradigm for air pollution monitoring, with a focus on lower cost measurements
- Develop and evaluate models and decision support tools to integrate multi-media processes and systems
- Develop approaches to assess multi-pollutant exposures and the resulting human and ecological effects of air pollutant mixtures
- Conduct research to inform policies protecting human and ecosystem health in an evolving energy landscape, including impacts of unconventional oil and gas and low-carbon energy sources.

# 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 manner are central 21st century challenges. These challenges are complicated by the interplay of air, the changing climate, and emerging energy options.

## **Vision:**

- The ACE program will provide cutting-edge scientific information and tools to support EPA's strategic goals to protect and improve air quality and address climate change.



# Input from ACE Partners (EPA)



## Office of Air and Radiation (OAR)

- Office of Air Quality Planning and Standards
- Office of Transportation and Air Quality
- Office of Atmospheric Programs
- Office of Indoor Air and Radiation

## Office of Enforcement and Compliance Assurance (OECA)

## Office of Water (OW)

## Office of Chemical Safety and Pollution Prevention (OCSP)



## EPA Regional Offices (R1-R10)

- Office of International and Tribal Affairs
- Office of Children's Health Protection
- Office of Policy (National Center for Environmental Economics)
- Environmental Justice

# Input from ACE Stakeholders



## Other Federal Agencies

- NIH: NIEHS, NHLBI
- Federal Highway Administration
- Centers for Disease Control
- Council on the Environment and Natural Resources and Sustainability (CENRS) – multiagency workgroup

- National Assoc. of Clean Air Agencies (NACAA)
- Environmental council of States (ECOS)

Industry (e.g., EPRI)

- Community action groups (R2: Ironbound)
- Community coordination (e.g., Las Vegas, Detroit near road)
- Tribal coalitions (visiting speakers)

- U.S. Global Change Research program (USGCRP)
- Intergovernmental Panel on Climate Change (IPCC)
- Global Alliance on Clean Cookstoves (GACC)

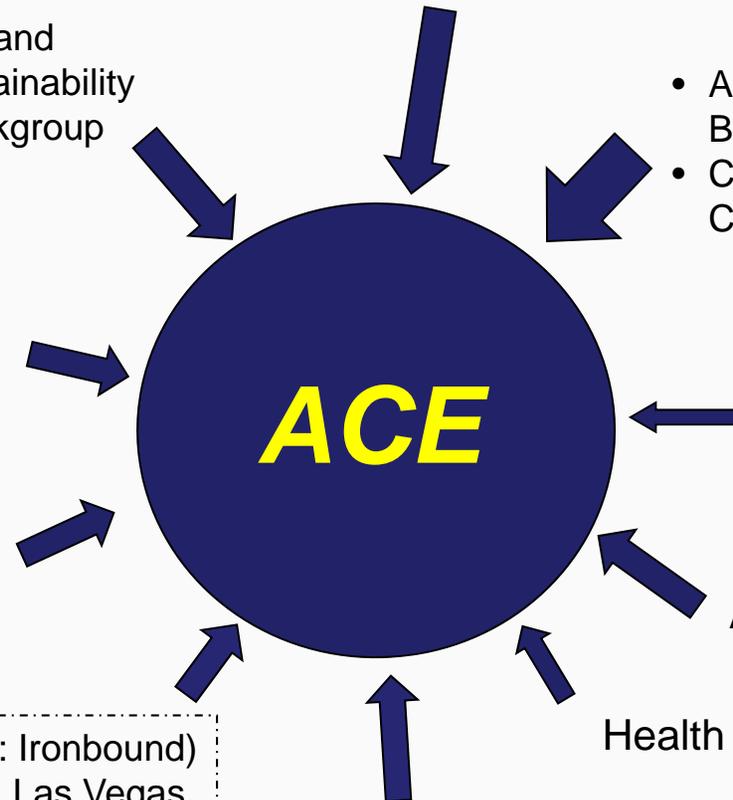
- Agency advisory groups (SAB, BOSC)
- Clean Air Science Advisory Committee (ISA review process)

Science Associations  
(annual meetings,  
workshops etc)

Academia

Health Effects Institute (HEI)

International links – EC, WHO



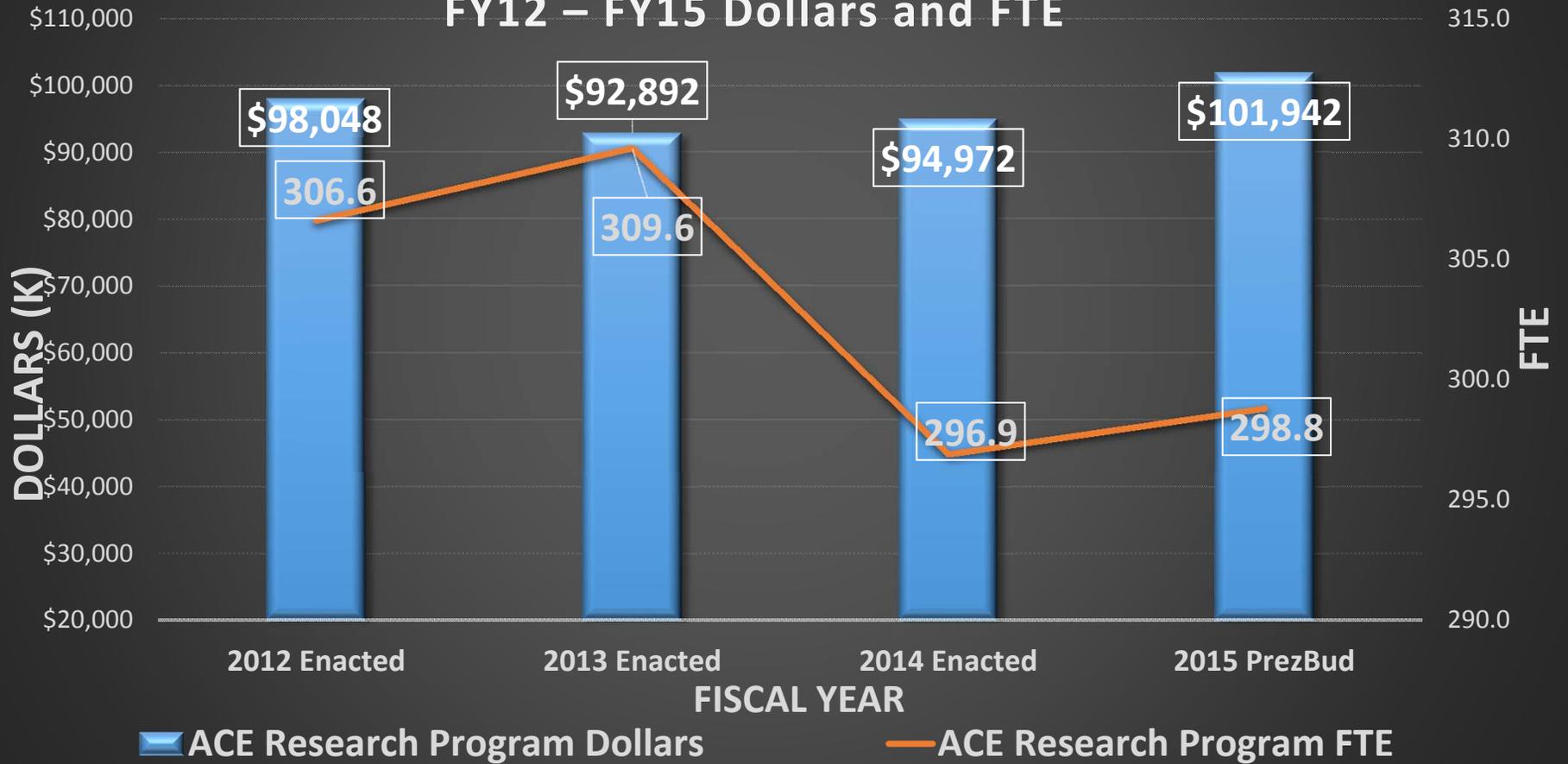
# Key Overarching Priorities for ACE



- The multipollutant nature of air pollution
- The incorporation of technology into monitoring networks
- Preparedness for 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
- Tools and models for 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
- Translating what we have learned for *real world* utility

# ORD – Air, Climate and Energy Research Program Resources

## FY12 – FY15 Dollars and FTE



# ACE Research Objectives



## Objective 1: Assess Impacts

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



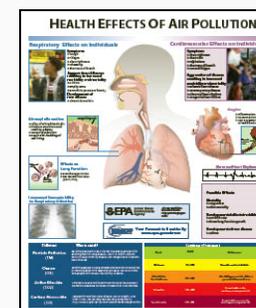
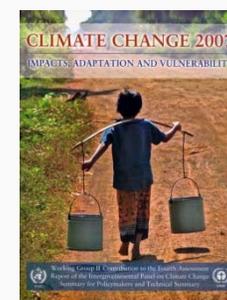
## Objective 2: Prevent and Reduce Emissions

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



## Objective 3: Prepare for and 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 Objectives & Research Topics

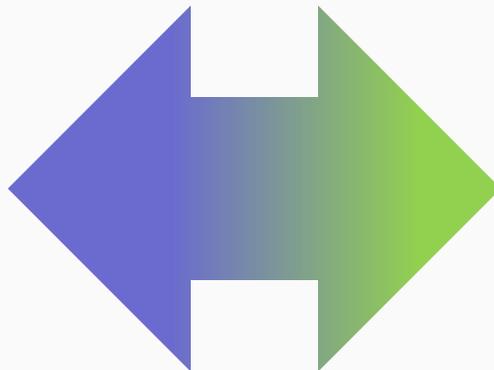


## ACE Objectives

**Objective 1:**  
Assess Impacts

**Objective 2:**  
Prevent / Reduce  
Emissions

**Objective 3:**  
Prepare for  
Changes



## ACE Research Topics for Partner Needs

Climate Impacts  
Mitigation and  
Adaptation

Emissions and  
Measurements

Modeling and  
Decision Support  
Tools

NAAQS and  
Multipollutant

Sustainable  
Energy  
Evaluation

<b>ACE Topic</b>	<b>Near-Term Targeted Research Aim</b>	<b>Long-Term Mission Driven Research Aim</b>
<b>Climate Impacts, Mitigation, and Adaptation (CIMA)</b>	Address climate change impacts on air and water quality, and human / ecosystem health	Develop sustainable climate adaptation and mitigation approaches
<b>Emissions and Measurements (EM)</b>	Develop and evaluate regulatory methods for source and ambient air monitoring	Change the paradigm for air pollution monitoring
<b>Modeling &amp; Decision Support Tools (MDST)</b>	Develop and evaluate local, regional, and hemispheric air quality modeling tools	Develop and evaluate models to integrate multimedia processes and systems
<b>NAAQS and Multipollutant (NMP)</b>	Inform NAAQS Reviews	Develop approaches to interpret multipollutant exposures and the resulting human and ecological effects of air pollutant mixtures
<b>Sustainable Energy Evaluation (SEE)</b>	Evaluate environmental impacts of energy technology	Inform policies protecting human and ecosystem health in an evolving energy landscape

# Current ACE Research Topics and Projects



ACE Topic	ACE Project
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
	<b>Sustainability, interactions, and co-benefits</b>
Emission and Measurements	Methods for Measurement to Inform Policy Decisions
	Improving Emissions Inventories using Measurements and Models
	<b>Changing the Paradigm for Air Pollution Monitoring</b>
Modeling and Decision Support Tools	Local- to Urban- to State-Scale MP Air Quality Models
	Regional- to Continental-Scale MP Air Quality Modeling
	<b>Integrated multimedia systems modeling for sustainability</b>
	Hemispheric- to Global-Scale MP Air Quality and Climate Models
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
	<b>Methodologies to Better Understand Multipollutant Exposures and Health Effects</b>
	Atmospheric Deposition Tools to Inform Secondary NAAQS
Sustainable Energy Evaluation	<b>Protecting Human and Ecosystem Health in an Evolving Energy Landscape</b>
	Energy from Biomass: Managing the Impacts of Emerging Bioenergy Pathways

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

# Examples of Signature Projects



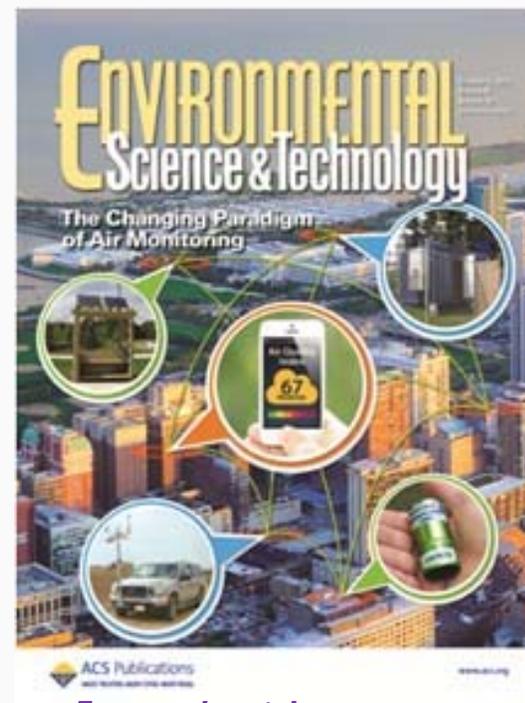
- Emission and Measurements
  - Changing the Paradigm for Air Pollution Monitoring (EM)
- NAAQS and Multipollutant
  - Methodologies to Better Understand Multipollutant Exposures and Health Effects (NMP)



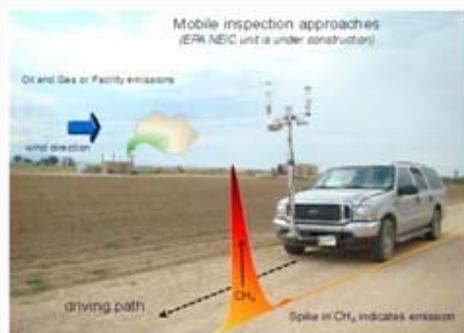
# (EM) Next Generation Air Monitoring



- Developing and stimulating new technology
- New innovations in facility fence-line monitoring
- Evaluating emerging sensor technology
- Promoting community participation in air monitoring
- Satellite-based air quality measurements



*Featured article on sensors*



*Mobile monitoring for geospatial mapping of pollutants (GMAP)*



*“Village Green” park bench monitors air quality*



**My Air  
My Health**

U.S. Department of Health and Human Services  
U.S. Environmental Protection Agency

*Jointly funded Innovation Project with NIEHS*

# The Village Green Project

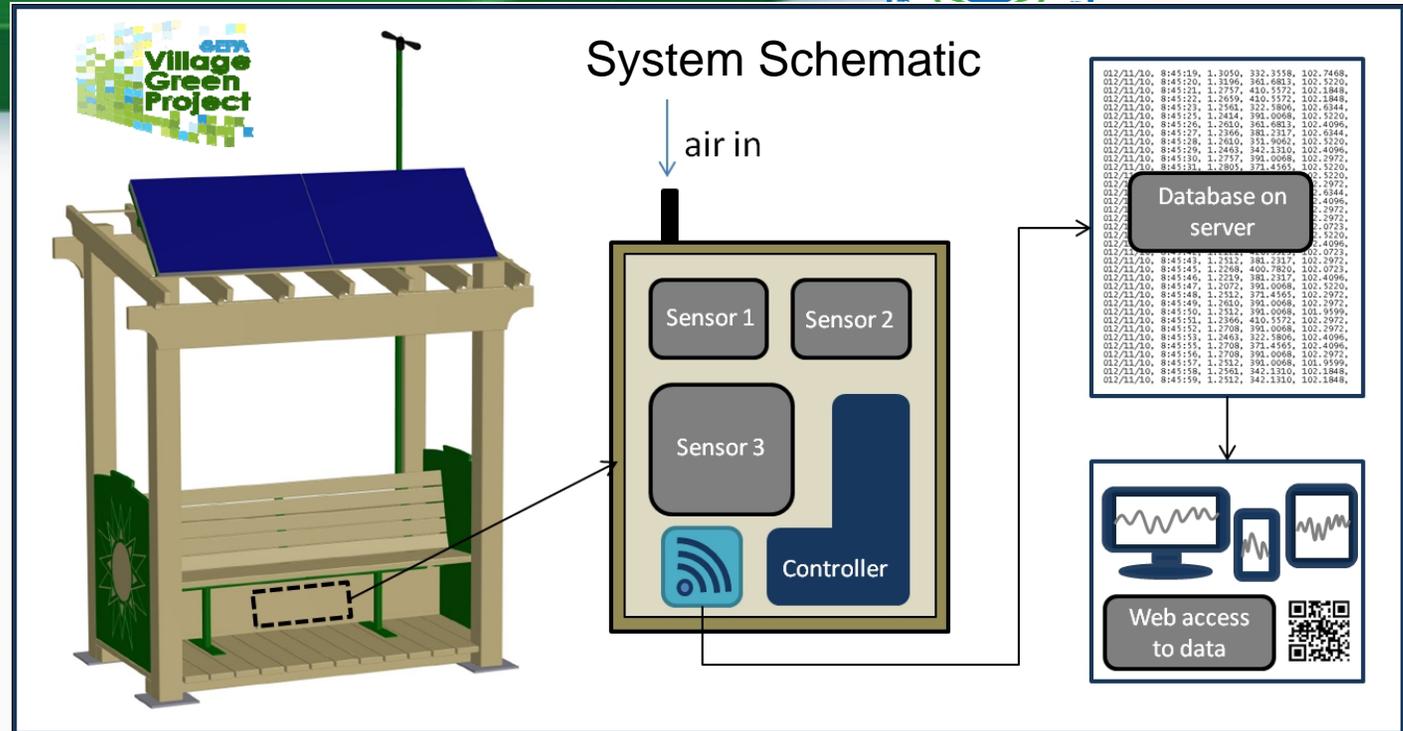


## Highlights:

> Sensors for PM, O<sub>3</sub>, BC, and meteorology. Operating only on solar since Oct 2012, >95% operational even in NC winter.

> Working with Durham County Library (VG serves as base for EPA-ACE outreach activities)

- Student and community science.
- Multiple requests for siting VG replicates in other locales.



Website – live streaming data (QC checks)

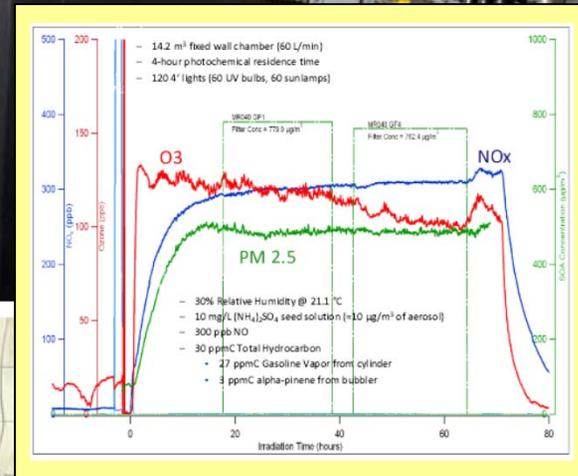


# Outreach - Village Green and Local Schools





# (NMP) Environmentally Controlled Smog Chamber for Climate and Air Quality Research

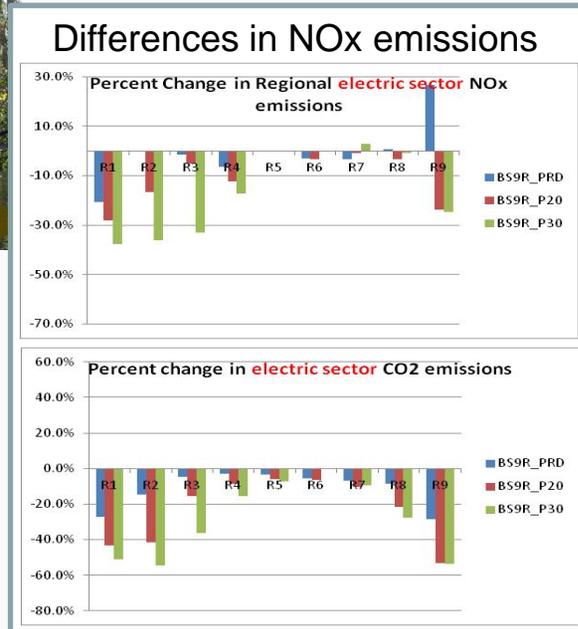
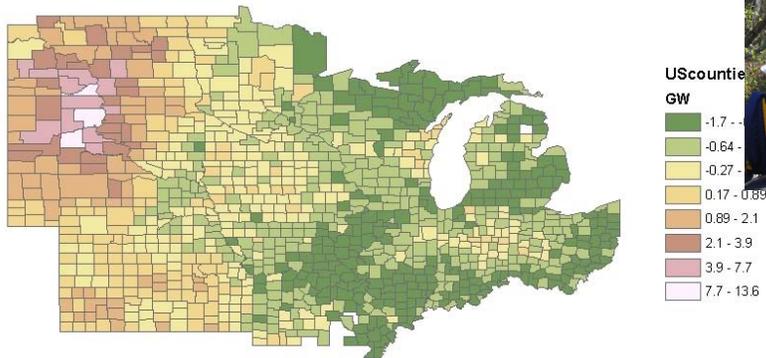


# (NMP) Interagency Collaboration on Secondary Oxidant Aerosols



- **Southeast Atmosphere Study:** EPA, NSF, NOAA, EPRI, academia) - extensive measurements across the Southeast to better understand SOA formation and its distribution
  - STAR Component: ACE STAR program funded [14 projects](#) to investigate each part of the organic aerosol system, including emissions, climate impacts, and interactions with man-made pollution
  - Media and Scientific Outreach: Dozens of unique newspaper articles, online stories, and videos about the field campaign reached media outlets and audiences across the country





**How does ACE put priorities into a relevant research portfolio?**

# *Information Exchanges – 2014*

*(Fluid and Continual Communication)*



- Biweekly ACE Update calls with ORD, Region, and Program Office staff
- Monthly Climate Calls
- Monthly to quarterly “chats” with OAR Division Directors
- Periodic updates with the *Research Coordination Team* that includes key staff from Program Offices and Regions
- In-person Regional visits; periodic updates on Regional Air Program Manager calls
- in-person participation in quarterly Regional Air Division Director meetings.
- In-person visits to Program Offices outside of RTP linked to DC travel

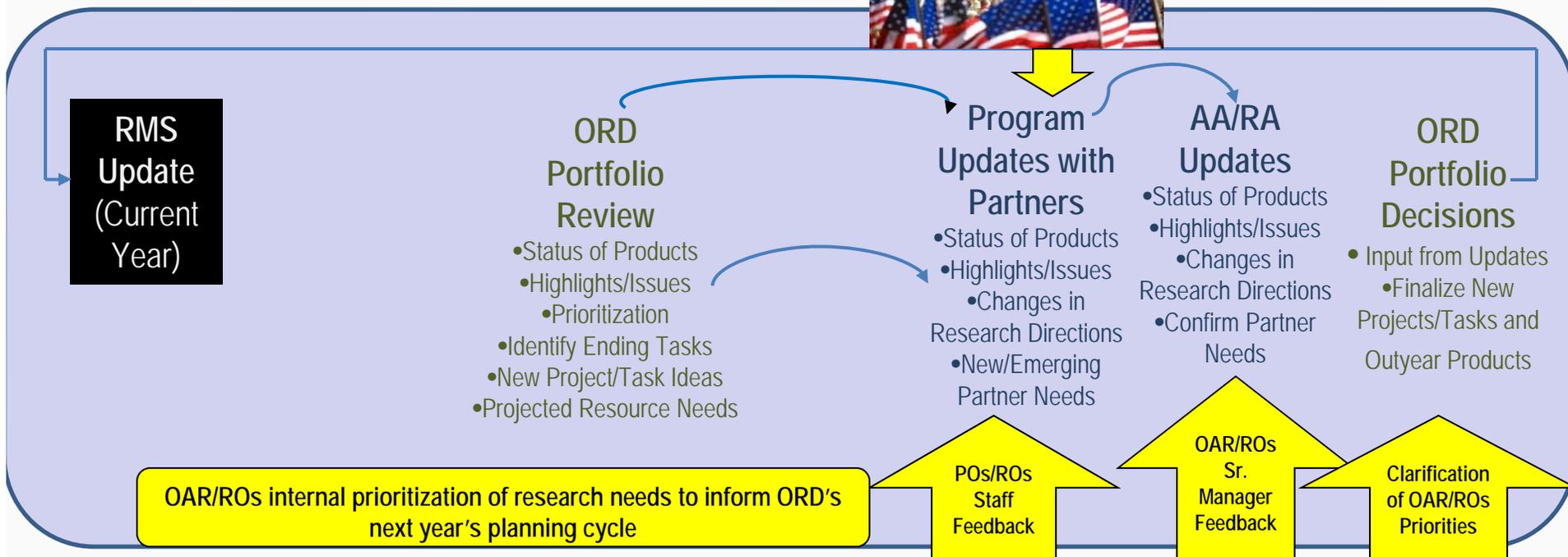
# *Information Exchanges – 2014*

*(Fluid and Continual Communication)*



- Web-based Quarterly newsletter – “*ACE Research News*”
- Monthly ACE / Clean Air Centers Webinars
- Annual ACE Jamboree: Face-to-face and video/web based
- Product manuscripts, reports, synthesis documents, project webinars etc.
- Formal annual needs updated by the Regions [organized by Lead Air Region]; Office of Air and Radiation; Office of Water (mostly climate), Office of Enforcement and Compliance Assurance (sensors) and partner offices (e.g., via cross program discussions).

# ACE Research Planning and Review Calendar



Oct | Nov | Dec | **Jan** | **Feb** | **Mar** | **Apr** | May | Jun | Jul | Aug | Sep

← Regular Meetings/Updates (see Communication / Coordination detailed in next slide) →

# ACE Support to EPA Regions



- Regional needs are a priority for the ACE Program
  - Technical support is a major activity
  - Goal: *Regional Test-beds* to enhance science relevance
  - Regional Applied Research Effort (RARE)
    - Ongoing projects in Regions 2, 4, 6, 8, 9, and 10
    - Most recent are a Citizen Science toolbox with Region 2 and emissions from control equipment at oil and gas production operations with Region 8
- Communication and coordination
  - Visit each Regional Office at least every 2-3 years
    - Often linked to other local meetings
  - ACE staff focus on ties to Regions and their immediate needs
    - Regional Bulletin Board – beta version available
  - ACE works closely w/ Reg. Science Leads (via the Air Lead)
    - Products delivery, needs and research coordination in RARE
  - Periodic broadcast through the Reg. Sci Council calls
  - Regional Scientist Exchange for common projects

# Region 2 RARE project with Ironbound Community

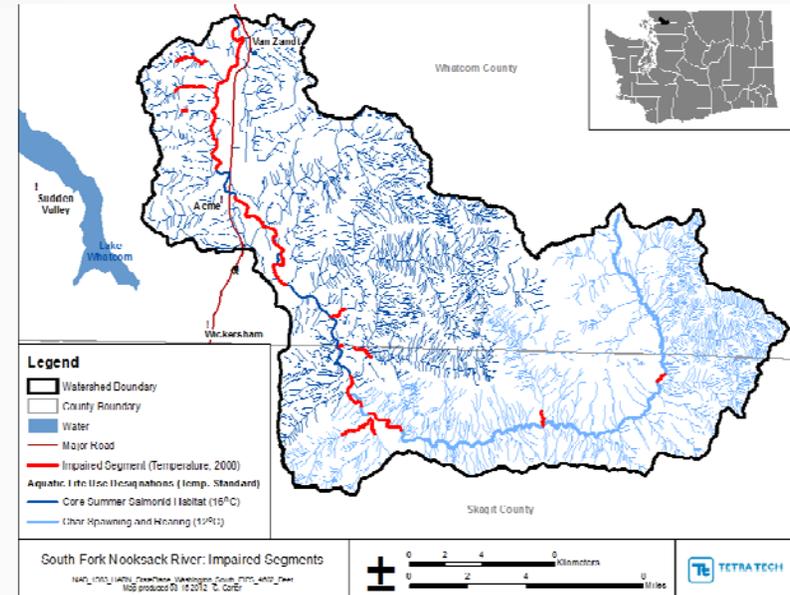


# Research to Support Region 10 TMDLs: Climate Change Impacts



## Key objectives:

- Assess potential impacts of climate change on stream temperature and stream flow in the South Fork Nooksack River watershed
- Prioritize stream restoration actions considering climate change
- Apply knowledge to guide implementation of EPA's *National Water Program 2012 Strategy: Response to Climate Change*.



**Desired outcome:** Address climate change in TMDL guidelines to protect salmon habitat and support recovery goals of ESA Salmon Recovery Plan

*Collaborative effort involving Region 10, OW, Nooksack Indian Tribe, State of Washington, USFS, NOAA Fisheries and USGS*

# Integrating Across ORD



- Nitrogen & co-pollutants: SHC, SSWR (Nitrogen Roadmap)
  - Developing measurement and modeling approaches to estimate deposition and ecological impairments of N & co-pollutants
  - Integrating multimedia models
- Life stage susceptibility to air pollution: CSS, SHC (Children's Roadmap)
- Near-source impacts of air pollution & social factors: SHC (EJ Roadmap)
  - Near-road, near-port & wildfires
- Climate change water quality impacts: SSWR, SHC (Climate Roadmap)
  - Watershed and infrastructure vulnerabilities
- Climate change resiliency: HSRP (Climate Roadmap)
- Air pollution & asthma: SHC (EJ and Children's Roadmaps)
- High-throughput evaluation of air pollutants: CSS (Pathfinder Innovation Project)
- Source-to-outcome research contributes to Integrated Science Assessments: HHRA

# The Big Picture of ORD Air and Climate Research



## Human Health and Risk Assessment (HHRA)

- Integrated Science Assessments (ISA)
- Multipollutant & Climate Science Doc. (MSD)
- Integrated Risk Information System (IRIS)
- Cumulative risk assessment

## Chemical Safety for Sustainability (CSS)

- Green Chemistry
- Predictive toxicology and exposure evaluation
- Children's health

## Air Climate and Energy (ACE)

- Health effects research (tox, epi, and clinical)
- Factors of susceptibility
- Air quality modeling (e.g. CMAQ) and monitoring technology (e.g. FRM, sensors)
- Mobile and stationary source and emissions
- Emissions, exposures, and effects near sources
- Climate impacts and interactions with air quality
- Nitrogen and sulfur deposition measurements and modeling

## EPA Air and Climate Programs

## Safe and Sustainable Water Resources (SSWR)

- Multimedia impacts of Nitrogen
- Climate air/water interface

## Sustainable and Health Communities (SHC)

- Community Decision Support Tools,
- Eco and health models
- Environmental Justice
- Asthma

## Homeland Security Research (HS)

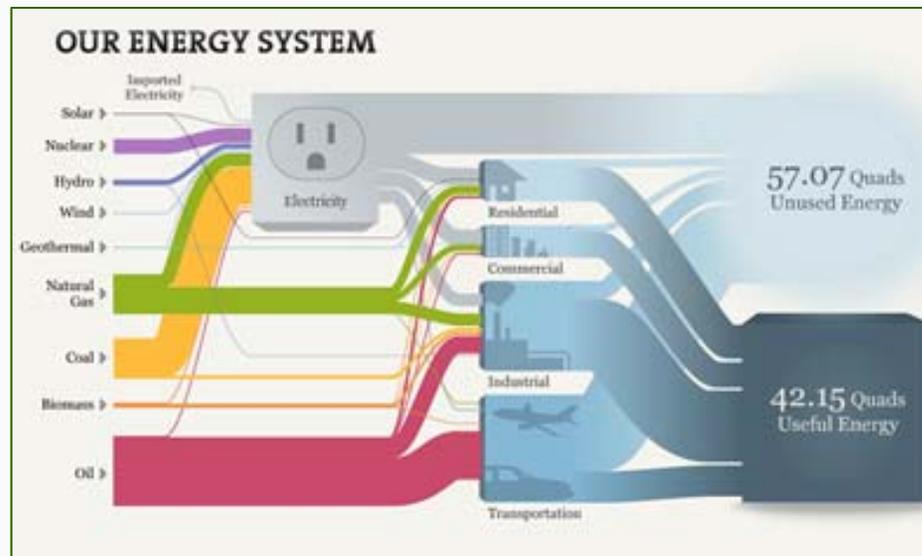
- Radiation measurement
- Emergency Response

# Proposed Approach to Sustainable Energy Evaluation



**Systems, Scenarios and Life Cycles:** evaluating and assessing the broader impacts of energy production and use from resource supply to end-use.

**Energy Extraction and Production:** measuring and characterizing the impacts of major changes in resource extraction and conversion.



**End-Use Impacts:** measuring and characterizing the impacts of major changes and shifts in patterns of energy use in end-use sectors.

Project Leads are currently analyzing options for clarifying the project scope and restructuring the work, in particular, looking at the energy system in a more holistic manner, without dividing biofuel and non-biofuel work in SEE projects. The current proposed structure for discussion is shown above.

# Sustainable Energy Evaluation



- With intensifying focus on climate, establishing the appropriate niche for ORD science and modeling skills to address energy choices and their uses in the context of community planning seems paramount. Current efforts include:
  - Energy futures: Modeling approaches to Renewable Portfolio Standards; future year emissions scenarios; commercial energy efficiency; and industrial energy
  - Exploring the relative value of potential mitigation approaches and technologies
  - Emissions: Cookstoves testing and health impacts; emission measurements and assessments
  - Biomass: Life cycle assessment for biofuels; use of biochar as carbon sequestration; viability of glycerol as a fuel; health impacts of associated pollens and molds

