

## Research to Inform Decision Making and Plans to Meet NAAQS

The following table lists anticipated Air and Energy (A-E) deliverables relevant to Charge Question 1. The Outputs and Products may change as new scientific findings emerge. Completion of Outputs and Products is contingent on appropriate resources being available. A-E will continue to actively engage with EPA Partners to meet their needs and inform the reviews of the NAAQS and implementation strategies.

Number	Research Area, Output, or Product Title
	<b><i>Research Area 1: Approaches to Support Air Quality Management for Multiple Pollutants at Multiple Scales</i></b>
<b>Output 1.1</b>	<b>Release of CMAQ v5.3 and Instrumented Versions Supporting Source Apportionment</b>
<b>Output 1.2</b>	<b>Release Updates to CMAQ and Instrumented Versions Supporting Source Apportionment</b>
AE.1.2.1	Evaluation of CMAQv5.3
AE.1.2.2	Factors Contributing to Ozone Formation Along Land-water Interfaces: Model-observed Inferences during the LISTOS Field Experiment
AE.1.2.3	Improvements for the Representation of the Emissions, Multiphase Chemistry, and Meteorology that Lead to Extreme Particle Episodes during Cold Conditions Using a Modeling Testbed for Alaska
AE.1.2.4	Improved Model Representation of Local, Regional and Global Distribution of Atmospheric Aerosols
AE.1.2.5	Land-use Specific Atmospheric Deposition Estimates to Support Chesapeake Bay TMDL Assessments
AE.1.2.6	Multi-model Inter-comparison of Deposition Estimates through Grid-based and Box Modeling
AE.1.2.7	Strengthening Transparency through Documentation of Air Quality Modeling Configurations and Delivery of Data Sets
AE.1.2.8	Modeling Evaluation of Ultrafine Particle Sources and Concentrations in the United States
AE.1.2.9	Machine Learning Approaches Applied to Chemical Transport Modeling
<b>Output 1.3</b>	<b>Development of Advanced Approaches to Estimate Background Contributions of Particulate Matter and Ozone</b>
AE.1.3.1	Development, Evaluation, and Application of a Multi-scale Modeling Platform to Estimate Ozone Concentrations and Source Contributions Over the Greater Denver Area
AE.1.3.2	Quantification of the Effects of Advances in the H-CMAQ and NextGen Modeling Systems on Simulated Background Pollution
AE.1.3.3	Development and Application of a Modeling Testbed for Improving the Characterization of the Natural Atmosphere

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AE.1.3.4	An Intercomparison of Modeling and Source Apportionment Approaches through External Collaborations Organized under the Task Force for Hemispheric Transport of Air Pollution (TF-HTAP)
AE.1.3.5	Estimated Decadal-scale Changes in Background Pollution Due to Divergent Trends in Global Emissions
<b>Output 1.4</b>	<b>Enhanced Monitoring and Modeling Approaches to Characterize Mesoscale Pollution Episodes</b>
AE.1.4.1	Evaluation of WRF-CMAQ Performance Using Advance Measurements from the Long Island Sound Tropospheric Ozone Study (LISTOS) Field Study
AE.1.4.2	Development and Implementation of a Common Mixing Height Algorithm and Prototype National Data Archive to Support the Photochemical Assessment Monitoring Stations (PAMS) Program (40 CFR part 58)
AE.1.4.3	Enhanced Monitoring of Column NO <sub>2</sub> and Formaldehyde via Ground-based Sun Spectrometers in Collaboration with NASA and ESA Pandora Global Network to Support PAMS Program
AE.1.4.4	Summary of Measurements and Modeling Approaches to Address the Atmospheric Loss of Reactive Nitrogen via Deposition (NO <sub>2</sub> and NH <sub>3</sub> )
AE.1.4.5	Improved Access to Enhanced Monitoring Data to Support EPA, State, and Local Air Quality Analysis via EPA Remote Sensing Information Gateway
AE.1.4.6	Advanced Measurements of Emissions, Chemistry, and Meteorological Parameters in US Persistent Nonattainment Areas: LISTOS Type Mesoscale Field Study Focus
<b>Output 1.5</b>	<b>Fine-scale Assessment and Mitigation Methods for Near-source Impacts</b>
AE.1.5.1	Development of Algorithm for Solid Noise Barrier for Use in Dispersion Models
AE.1.5.2	Summary of Approaches for Mitigating Near-Source Ambient Air Impacts Using Urban Design
AE.1.5.3	Estimates of Community Air Quality Impacts from Freight Transport Operations
AE.1.5.4	Summary of Factors Influencing Criteria Air Pollutant Concentrations at Near-Road Monitoring Network Sites
AE.1.5.5	Summary of Techniques to Incorporate Satellite Data to Improve Characterization of Fine-Scale Air Quality and Source Impacts
AE.1.5.6	Summary of Spatial Analysis of Volatile Organic Compounds in Rubbertown Area of Louisville, Kentucky using Passive Samplers
AE.1.5.7	Improved Modeling Approaches for Characterizing the Flow and Dispersion of Air Pollutants in Urban Areas for Use in Dispersion Models
<b>Output 1.6</b>	<b>Evaluation of Organic Species Impacting Criteria Pollutant Formation</b>

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AE.1.6.1	New Insights in Atmospheric Science Seminar Series
AE.1.6.2	Summary of Implications of VCPs for Ozone and PM in Urban Atmospheres (California and the Northeast US)
AE.1.6.3	Summary of Mechanistic Study of the Oxidation Processes of Limonene
AE.1.6.4	Summary of Identification of VCP-driven Criteria Pollutant Exceedances Nationwide in the Context of Changing NOx
AE.1.6.5	Summary of Laboratory Determination of SOA and Ozone from Volatile Chemical Products (VCPs)
AE.1.6.8	Summary of a Multimodel Approach to Chemical Prioritization Based on Primary and Secondary Pollutant Exposure Across Environments Resulting from Volatile Chemical Products
AE.1.6.10	Development of a VCP Emission Inventory Methodology and Tool
AE.1.6.11	Update the Regional Atmospheric Chemistry Mechanism in CMAQ
	<b><i>Research Area 2: Approaches for characterizing source emissions, air quality, exposure, and mitigation strategies</i></b>
<b>Output 2.1</b>	<b>Progress update on the characterization and mitigation of key combustion sources</b>
AE.2.1.1	Description of carbonaceous particle emissions from a pellet-burning biomass boiler
AE.2.1.3	Summary and dataset on emissions characterization of NOx, VOC, SVOC, PM emissions from both light and heavy-duty vehicles
AE.2.1.5	Summary of emissions from off-road stationary diesel gensets operating on traditional and alternative fuels
AE.2.1.6	The SPECIATE Database
AE.2.1.7	Summary of Emissions Measurements and Exposures from Non-Road Engines
AE.2.1.8	Summary of emissions from a pilot-scale investigation for the co-combustion of various biomass materials and coal
AE.2.1.9	Summary of Investigation of Stationary Source Condensable PM Measurements
AE.2.1.10	Summary of Program Office Source Emissions Methods Development and Revisions Support
AE.2.1.12	Summary of the impact of appliance technology, fuel, and measurement method on the emissions from residential wood combustion
AE2.1.13	Chemical composition of biomass burning emissions by fuel type and combustion conditions
<b>Output 2.2</b>	<b>Development, Evaluation, and Implementation of Updated Ambient Air Measurement Methods</b>
AE.2.2.1	Summary of Ozone Measurement Methods in Biomass Burning Plumes
AE.2.2.4	FY20 Activity Report of ORD's Reference and Equivalent Methods Designation Program
AE.2.2.5	Continuous Formaldehyde Method Development and Evaluation

Number	Research Area, Output, or Product Title
AE.2.2.6	FY21 Activity Report of ORD's Reference and Equivalent Methods Designation Program
AE.2.2.7	FY22 Activity Report of ORD's Reference and Equivalent Methods Designation Program
<b>Output 2.3</b>	<b>Progress update on fugitive, area source, fenceline, and roadway emissions research</b>
AE.2.3.1	Summary of Emission Factors of Reduced Nitrogen and Sulfur Compounds from Biomass Combustion
AE.2.3.2	Development of Aerial Emission Sampling Methods
AE.2.3.3	FY20 Annual Summary of NGEM and Fugitive, Area Source, and Fenceline Research
AE.2.3.4	FY21 Annual Summary of NGEM and Fugitive, Area Source, and Fenceline Research
AE.2.3.5	Summary of Study Results of Brake and Tire Wear from On-Road Motor Vehicles
AE.2.3.6	Summary of results of field evaluation of portable automated gas chromatographs for near source VOC monitoring
AE.2.3.7	FY22 Annual Summary of NGEM and Fugitive, Area Source, and Fenceline Research
<b>Output 2.4</b>	<b>Summary of research advancements to characterize emissions, exposures, and related health and environmental impacts associated with solid-fuel combustion for household energy needs (cooking, heating, and lighting) and outline of priorities for future research</b>
<b>Output 2.5</b>	<b>Emission Estimating Methodologies (EEMs) and future research needs for emissions from agricultural sources</b>
AE.2.5.1	Draft Emission Estimating Methodologies (EEMs) for ammonia, hydrogen sulfide, and particulate matter emissions from swine, poultry (broiler and layer), and dairy farms
<b>Output 2.6</b>	<b>Methods for Estimating Methane Emissions from Surface Water Reservoirs for the U.S. GHG Inventory Report</b>
AE.2.6.1	Summary of Temporal Patterns and Biophysical Controls on Methane Emissions from Reservoirs
AE.2.6.2	An Estimate of Methane Emissions for U.S. Reservoirs for Inclusion in the Annual Inventory of U.S. Greenhouse Gas Emissions and Sinks
	<b><i>Research Area 7: Emerging Approaches to Improve Air Quality and Exposure Characterization</i></b>
<b>Output 7.1</b>	<b>Advancement of Methods in Combining Different Types of Observational and Model Data for Air Pollution Characterization</b>
AE.7.1.2	Summary of Next Generation Methods and Citizen Science Data to Evaluate Source Emissions and Impacts
AE.7.1.3	Summary of Exposure Characterization Using Data from Air Sensors, Reference Monitors, Satellites, and/or Air Quality Models to Understand Potential Public Health Impacts

Number	Research Area, Output, or Product Title
<b>Output 7.2</b>	<b>Improved Capability to Manage, Process, Analyze, and Visualize Next-generation Air Pollution Data</b>
AE.7.2.1	Report on Stakeholder Needs Assessment for Air Sensors
AE.7.2.2	Report on Data Solution Investigation for Air Sensors
AE.7.2.3	Summary of Internal Pilot of an Air Sensor Data Management Scheme to Support EPA Research and Air Quality Messaging
AE.7.2.4	Summary of Air Sensor Data/Network Data Quality Assurance Methodology
AE.7.2.5	Development of an Air Sensor Data Analysis Application
AE.7.2.7	Summary List of Public Resources to Facilitate the Use of Air Sensors
<b>Output 7.3</b>	<b>Air Quality Sensors-Performance Evaluation, Targets Development, Testing Protocols, and Best Practices Guidance</b>
AE.7.3.1	Air Sensor Performance Targets and Test Protocols for PM2.5 and Ozone
AE.7.3.2	Air Sensor Performance Targets and Test Protocols for PM10, NO2, SO2, CO
AE.7.3.3	Update to Air Sensor Guidebook
AE.7.3.4	Summary of Air Sensor Evaluations
AE.7.3.6	Summary of Evaluation of Commercially Available Air Sensor Performance in Biomass Burning Plumes
<b>Output 7.4</b>	<b>Development of Advanced Air Quality Modeling Approaches for Global to Urban Scales</b>
AE.7.4.1	Summary and Evaluation of MPAS Retrospective Meteorology Applied to Global Air Quality Modeling
AE.7.4.2	An Advanced Visualization Environment for Rich Data Interpretation (VERDI) Visualization and Analysis Tool for Next Generation Air Quality Modeling on Global Icosahedral-type Grid Meshes
AE.7.4.3	Updated Model with Atmospheric Chemistry Over Marine Environments and Evaluation
AE.7.4.4	Software Tools for the Generation of MPAS Horizontal Meshes to Support Global to Regional Coupled Meteorology and Air Quality Modeling
AE.7.4.5	Advanced Urban Canopy Model Components for High-resolution Meteorology and Air Quality in Urban Areas
AE.7.4.6	Updated Global Air Quality Model with Improved Soil and Surface Representation Incorporating Global Satellite Products
AE.7.4.7	Updated Air Quality Model with Aerosol-Met Interactions Including Direct and Indirect Radiative Feedback Effects
AE.7.4.8	Prototype Regional Version of the Advanced Air Quality Modeling System
AE.7.4.9	2-way Coupled MPAS-AQ Model