

Appendix IV-a. NARSTO Contributions: Recent Web Search Results

NARSTO efforts and products are widely relied upon and cited in scientific journal publications and in government assessments, reports and regulatory actions at the federal, state/provincial and international levels. A representative compilation of some of these citations, regulations and reports is provided below.

Citations in Atmospheric Science Literature

A recent (Jan. 2009) SCOPUS search for NARSTO citations in the scientific research literature revealed NARSTO references in 539 scientific publications between 1997 and 2009, including 61 conference papers, 67 review papers and 410 journal articles. These citations occurred in over 100 different scientific journals, most prominently in *Atmospheric Environment* (140 papers), *JAWMA* (52), *Environmental Science and Technology* (29), *Atmospheric Chemistry and Physics* (23) and *Journal of Geophysical Research – Atmospheres* (21 papers). These SCOPUS search results are included in the attached spreadsheet: NARSTO–1997-2009.csv

U.S. EPA Rulemakings and Supporting Documents

- **Clean Air Interstate Rule (CAIR)** to address transported SO₂ and NO_x emissions related to meeting ozone and particulate matter standards [Final rule, 4/12/05, pages 25179, 82-83 and 85]. Cites the NARSTO PM and Ozone Assessments, most notably, stating that 1) further information on PM can be found in the PM NAAQS Criteria Document and the NARSTO PM Assessment, and 2) OTAG and the NARSTO Ozone Assessment prove the relationship between NO_x emissions and ozone transport.
- **Clean Air Fine Particle Implementation Rule** to implement 1997 PM_{2.5} standard. [Final rule, 4/25/07, page 20591]. Cites the NARSTO PM Assessment related to the formation of particles related to ammonia emissions.
- **New Source Review Program for PM_{2.5}** [Final rule, 5/16/08, page 28330]. Cites NARSTO PM Assessment related to the final decision on ammonia.
- **Air Emissions Reporting Requirements** [Proposed rule, 1/3/06, page 73]. Cites – cites EPA's ultimate goal to complete the National Emission Inventory within 12 months of the end of a calendar year as being consistent with recommendations made by external groups (e.g., NARSTO's Improving Emission Inventories for Effective Air Quality Management Across North America).
- **Ozone Criteria Document** (March 2006) to describe science and health issues:
 - ✓ Vol. 1 cites a 1997 Blumenthal et al. report on the OTAG website regarding transport and mixing phenomenon related to ozone exceedances in the Northeast US, based upon

- NARSTO Northeast data; the Southern California Oxidant Study via articles by Grosjean citing NARSTO data; and the NARSTO Ozone Assessment regarding ozone ambient trends.
- ✓ Vol. 2 – Gong et al 2000 Atmos. Env. article re: 1996 NARSTO-CE field campaign; 2000 Russell et al. Atmos. Env. re: NARSTO critical review of photochemical models and modeling; and a 2000 Sawyer et al. Atmos. Env. article re: 1998 NARSTO assessment, mobile sources critical review.
 - **Particulate Matter Criteria Document** (October 2004, Vol. 1) to describe science and health issues:
 - ✓ On page 1 of Chapter 2 (Physics, Chemistry and Measurement of Particulate Matter) the text states “The reader is referred to the NARSTO Fine Particle Assessment (NARSTO, 2003) for information relevant to air quality management for PM.”
 - ✓ On page 3-93, on the topic of chemistry-transport models, the text states “CTMs are an integral part of air quality management programs and are reviewed in the NARSTO *Fine Particle Assessment*.”
 - **Regional Haze Regulations** and Guidelines for Best Available Control Technology [Final rule, 6/25/05, page 39113]. States that NARSTO’s PM Assessment said that consideration of control strategy need to include ammonia in combination with other precursors to particle formation.
 - **Interim Guidance on Control of Volatile Organic Compounds in Ozone State Implementation Plans** (September 13, 2005 Federal Register, <http://www.epa.gov/ttncaaa1/t1/meta/m27601.html>).
 - ✓ This notice discusses EPA’s participation in the Reactivity Research Working Group (RRWG), which was organized to help develop an improved scientific basis for reactivity-related regulatory policies. The notice devotes substantial discussion to the RRWG participants.
 - ✓ It notes that the RRWG organized a series of research projects that “has led to a number of findings that increase our confidence in the ability to develop approaches that discriminate between VOCs on the basis of reactivity.”
 - ✓ It adds that “EPA encourages all interested parties to continue working through the RRWG to improve the scientific foundation of VOC reactivity-based regulations. EPA will continue to update its guidance to States as new information becomes available. In the meantime, EPA encourages States to take advantage of the information that is now available in designing future VOC control strategies.”

- ✓ On the same date (9/13/05), EPA also issued final approval to California's reactivity-based aerosol coating control SIP revision.
- **EPA Approval of California SIP Revision specifying Reactivity-Based Regulation of Aerosol Coating Products.** EPA approved adding CARB's aerosol coatings reactivity-based regulation and associated MIR tables into its SIP; granting SIP credit for the equivalent mass-based reductions achieved by CARB's regulation, and modifying our (EPA's) regulatory definition of VOC at 40 CFR 51.100(s) to support the CARB's regulation. EPA's proposed rule [Fed. Reg.: 1/7/05 (Vol. 70, No. 5), <http://www.epa.gov/EPA-AIR/2005/January/Day-07/a346.htm>] includes a review of EPA and CARB participation in the NARSTO Reactivity Research Working Group (RRWG), and cites several findings from RRWG reports. The Final EPA rule [Fed. Reg.: 9/13/05 (Vol. 70, No. 176), <http://regulations.justia.com/view/23068>] notes that "The EPA will continue to work with the CARB and other interested parties through the Reactivity Research Working Group (RRWG) to improve the scientific foundation of VOC reactivity-based regulations." For additional detail on RRWG see: "RRWG and NARSTO – Overview".
 - **National Volatile Organic Compound Emission Standards for Aerosol Coatings.** Following its approval of CARB SIP revisions for reactivity-based regulation of aerosol coatings, EPA proposed and finalized national reactivity-based VOC emissions regulations for aerosol coatings. The proposed rule [Fed. Reg. 7/16/07 (Vol. 72, No. 135), <http://www.epa.gov/EPA-AIR/2007/July/Day-16/a13108.htm>] includes discussion of the NARSTO RRWG activities, research projects and findings. The Final rule was issued November 7, 2008 [Fed. Reg. 11/7/08 (Volume 73, Number 217), <http://edocket.access.gpo.gov/2008/E8-26614.htm>].
 - **Transportation Conformity Rule Amendments for the New PM_{2.5} National Ambient Air Quality Standard: PM_{2.5} Precursors**, [Fed. Reg.: 5/6/05 (Vol. 70, No. 87)] In response to comments suggesting poor scientific understanding of the formation of secondary particles, EPA responded that "there is clear evidence and a substantial understanding of the role of NO_x and SO_x in the formation of secondary particles. Additional information on the role of each of the precursors can be found in the U.S. EPA Criteria Document, and in the NARSTO Fine Particle Assessment." <http://www.epa.gov/EPA-AIR/2005/May/Day-06/a9086.htm>

United States – State and Regional Air Management Agencies

- **An Overview of the NARSTO Emission Inventory Assessment: Improving Emission Inventories for Effective Air-Quality Management Across North America**, September 2005 – NARSTO briefing for STAPPA/ALAPCO. This presentation stated that "Increased investment in emission inventories can make controls more effective." It provides as an

example: “In Houston, emissions from petrochemical facilities are particularly important. When these estimates were improved, a new control strategy was developed that should result in more effective air-quality management and yield savings of \$20B (over a 10 year period) compared to the original strategy. “ [A similar presentation -- Improving Emission Inventories for Effective Air Quality Management Across North America, by Marc Deslauriers, Environment Canada to the Joint UNECE TFEIP & EIONET workshop, Rovaniemi, October 2005 – stated that “Houston Texas case showed “savings” of \$9B over a 10 year period with revised emission inventory and a revised control strategy.”]

<http://tfeip->

[secretariat.org/rovaniemi/Presentations/TFEIP_EIONET_Workshop/NARSTO_Deslauriers.pdf](http://tfeip-secretariat.org/rovaniemi/Presentations/TFEIP_EIONET_Workshop/NARSTO_Deslauriers.pdf)

- **The Nature of the Ozone Air Quality Problem in the Ozone Transport Region: A Conceptual Description.** Prepared for the Ozone Transport Commission by NESCAUM, Boston, MA. October 2006. This report contains numerous references to NARSTO materials. <http://www.nescaum.org/documents/2006-1013b-o3-conceptual-model-draft-final-all.pdf>
- **Ozone Transport Assessment Group (OTAG) Air Quality Analysis & Modeling.** Measurement data and analysis results from the SOS and NARSTO-Northeast field studies provided timely contributions to inventory, modeling and especially data analysis activities of the OTAG workgroups (Eastern states + EPA + stakeholders), ultimately leading to the 1998 EPA NO_x SIP calls in 22 Eastern States. For more specific examples of NARSTO-Northeast contributions to OTAG and air quality analysis tools see: “NARSTO-NE & OTAG AQA”.
- **State Section 126 Petitions**
 - ✓ New Hampshire 126 Petition under for Abatement of Excessive Emissions contributing to Ozone Nonattainment
<http://des.nh.gov/organization/divisions/air/do/asab/pm/documents/126final.pdf>
 - ✓ Vermont Technical Support Document to Section 126 Petition to abate excessive emissions by fossil fuel fired electric generating facilities interfering with Vermont’s maintenance of the National Ambient Air Quality Standards for Ozone
<http://capita.wustl.edu/NEARDAT/Reports/vt126/v126tech.PDF>
- **MANE-VU Regional Planning Organization:** Contributions to Regional Haze in the Northeast and Mid-Atlantic United States: Mid-Atlantic/Northeast Visibility Union (MANE-VU) Contribution Assessment (<http://www.manevu.org/Document.asp?fview=Reports#>). Frequent citations to NARSTO PM Assessment to document statements on fine particle emissions, formation, composition, transport and contributions to visibility impairment.

- **Environmental Monitoring, Evaluation and Protection (EMEP) Program: Air Quality Research Program Opportunity Notice (PON) 1179.** New York State Energy Research and Development Authority (NYSERDA). Proposals Due: November 6, 2007. This Request for Proposal describes the need for “Emissions Inventory—Better Characterization of Currently Poorly Characterized Sources.” It states that “A recent assessment by NARSTO, “Improving Emission Inventories for Effective Air Quality Management Across North America,” identified many areas in need of improvement. Due to regional variations in air quality and source types, and the cost of measuring emission factors, efforts to improve the emissions inventory should have a regional focus and involve U.S. EPA and adjacent states and provinces. A Regional Emissions Inventory Workshop sponsored by NYSERDA and others is planned for fall 2008 to address this objective.”
- **Development of the SAPRC-07 Chemical Mechanism and Updated Ozone Reactivity Scales.** Final Report to the California Air Resources Board. Contract No. 03-318, William P. L. Carter, August 31, 2007, University of California, Riverside. This report notes that the California Air Resources Board (CARB) is obligated to update the reactivity scales used in its regulations approximately every three years so they reflect the current state of the science. Since the mechanism was developed in 1999, updates to the mechanism and the reactivity scale are now due. Another reason for updating the SAPRC mechanism is to make it more suitable for prediction of secondary particulate matter (PM). The major accomplishment of this project is the development of the SAPRC-07 chemical mechanism and its associated reactivity scales, which are documented in this report. The report makes references to the RRWG and NARSTO products and recommendations. <http://www.engr.ucr.edu/~carter/SAPRC/saprc07.pdf>

Mexico – National Emission Inventory Reports

- **National Emissions Inventory 1999. Report from National Institute of Ecology.** (Inventario Nacional de Emisiones. Informe del Instituto Nacional de ecología) (Published in 2006) This document cites the *Southern California Ozone Study – North American Research Strategy for Tropospheric Ozone*
- **Manual Course for elaboration and use of Emissions Inventories.** (Manual para el curso de elaboración y uso de inventarios de emisiones). This document cites the *Improving Emission Inventories for Effective Air Quality Management Across North America*.

Canada – Federal Government

- **Science support for the Federal Department of the Environment addition of Ozone and its Precursors to the list of Toxic Substances in Schedule 1 of the *Canadian Environmental Protection Act, 1999***

Canada - Federal-Provincial/Territorial

The Canadian Council of Ministers of the Environment (CCME), with all federal, provincial and territorial governments represented, has used NARSTO products as a key science foundation for the Canadian national review of the Canada-Wide Standards (CWS) for PM and ozone.

- The 2003 science review of the CWSs for PM and Ozone prepared for the CCME used the following NARSTO reports and assessments to review the Canadian standards for PM and Ozone:
 - ✓ *VOC Reactivity Science Assessment.*
 - ✓ *An Assessment of Tropospheric Ozone Pollution - A North American Perspective.*
 - ✓ *Particulate Matter Science for Policy Makers.*
- CCME used the NARSTO reports and assessments to review and evaluate:
 - ✓ Canadian measurement networks, their objective and relevance, and their current capabilities and needs;
 - ✓ The state of measurement technology including evaluation of measurement accuracy, instrumentation for *in situ* surface measurement, remote sensing, and measurement from aircraft. Improving results and the availability of remote optical measuring instruments such as DOAS and LIDAR were noted.
 - ✓ Value of measurements of ozone and precursor concentrations at increasing heights in the planetary boundary layer to improve knowledge of pollutant mixing and transport and to bring insight into processes affecting pollutant characteristics on a regional scale.
 - ✓ VOCs reactivity with respect to its significance to air quality management. The management strategy recommendations made by NARSTO were important with respect to controls for VOCs with the highest ozone-forming potential, the relative effect of a VOCs depending on its complete reaction suite, discussion and comparison of existing scales (MIR, MOIR (Maximum Ozone Incremental Reactivity), POCP); and recommendations for reactivity evaluations that address the regional scale rather than the urban (e.g. Los Angeles scale).
 - ✓ Model intercomparisons.

Provincial governments – Ontario

- The province of **Ontario's Ministry of Environment** participates in NARSTO and has used it as a source of scientific information in support of policy actions such as tracking NO_x and VOC reduction compliance activities under U.S. State Implementation Plans.
- NARSTO activities and reports are cited in Ontario MOE **Proposed Performance Indicators for Ontario's Anti-Smog Action Plan**; A progress report developed by the Performance Monitoring and Reporting Work Group (PMRWG) <http://www.ene.gov.on.ca/programs/3951e.pdf>
- **Also, Ontario** has used NARSTO as an important source of scientific information in preparing legal submissions to the United States Environmental Protection Agency on transboundary air pollution.

Joint Canada-United States Efforts

- **Canada-United States Transboundary Particulate Matter Science Assessment**, A Report by the Canada-U.S. Air Quality Committee, December 2004. The NARSTO PM assessment is the primary source of information for this report, which is being used to negotiate a PM Annex to the Canada-US Air Quality Agreement. <http://www.epa.gov/airmarkets/progsregs/usca/docs/transboundary.pdf>
- **US-Canada Air Quality Agreement – Progress Reports, 1998 through 2008**, NARSTO activities and/or assessments have been cited in each biennial progress report of the Canada-US Air Quality Committee from 1998 through 2008. <http://www.epa.gov/airmarkets/progsregs/usca/index.htm>

International Air Quality Advisory Organizations

- **World Health Organization Air Quality Guidelines, Global Update 2005** (<http://www.euro.who.int/Document/E90038.pdf>) In this WHO update recommending air quality guidelines and interim target levels for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, the NARSTO PM Assessment is cited in various summarizations of North American PM concentrations, composition and exposure levels and in describing current and developing PM measurement methods.