



Rethinking NARSTO

**Conclusions and Recommendations
of an External Review Panel
March 2009**

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FOREWORD

In response to a formal request from the NARSTO membership, the NARSTO Review Panel was established to respond to questions regarding the value of NARSTO to its participants and what changes, if any, might be considered to improve its focus, structure or function.

This report presents the results the panel's review of past and present NARSTO activities, as well as summaries of responses to questionnaires and personal interviews from over sixty individuals chosen on the basis of their background, interest, experience and responsibility within their organizations. The panel appreciates the thoughtful responses to its inquiries.



NARSTO Review Panel Members (left to right): John Kinsman, Dr. Agustin García, Edward W. Piché, Jane C. Barton, Richard Poirot, Dr. Carol J. Henry.

Several people assisted the panel by providing information related to the issues addressed in this report. The panel gratefully acknowledges contributions from Jeremy Hales, past NARSTO Management Coordinator; William Pennell, current NARSTO Management Coordinator; and Jeffrey West, NARSTO Associate Management Coordinator. We also thank Deborah Garland of the Oak Ridge Institute for Science and Education and Diane Fleshman of the NARSTO Management Coordinator's Office for administrative assistance.

Finally, I would like to thank the members of the Review Panel for their expertise and dedicated effort throughout the development of this report.

Carol J. Henry
Chair, NARSTO Review Panel

About NARSTO:

NARSTO is a public/private partnership whose membership spans government, the utilities, industry, and academia throughout Canada, the United States, and Mexico. NARSTO's primary mission is to coordinate and enhance policy-relevant scientific research and assessment of tropospheric pollution behavior. Its activities provide input for science-based decision-making and determination of workable, efficient, and effective strategies for local, regional, and international air-pollution management. NARSTO was formerly an acronym for "North American Research Strategy for Tropospheric Ozone." However, in 1999 the NARSTO charter was revised to address research and development with respect to primary and secondary pollutant species emitted, formed, transformed, and transported in the troposphere over North America. As a result the term NARSTO has become a word mark signifying this tri-national, public-private partnership for dealing with multiple features of tropospheric air pollution. More information on NARSTO can be found at <http://www.NARSTO.org>.

PANEL MEMBER BIOGRAPHIES

Carol J. Henry - Chair

Carol J. Henry is an advisor and consultant to public and private organizations, focusing on issues in toxicology and risk assessment, public and environmental health, and domestic and international science and public policy. She has lectured on uncertainty in risk assessment, biomonitoring, public engagement on scientific issues, innovation and entrepreneurship in the chemical industry, and standards and practices for health and environmental research. She was recently appointed Professorial Lecturer at the George Washington University School of Public Health, Washington, DC.

She retired as Vice President, Industry Performance Programs at the American Chemistry Council (ACC) in November 2007. Previously, Dr. Henry held executive leadership positions at the American Petroleum Institute, the U.S. Department of Energy, the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment, and the International Life Sciences Institute's Risk Science Institute.

She is a member of the Montgomery County Maryland Water Quality Advisory Group, the Federal Advisory Committee for the National Children's Study; the Board on Chemical Sciences and Technology of the National Research Council; the Environmental Health Perspectives Editorial Board; the American College of Toxicology, of which she has been president; the Society of Toxicology; and the American Association for the Advancement of Science. She is currently President of the Chemical Society of Washington of the American Chemical Society.

Dr. Henry received her undergraduate degree in chemistry from the University of Minnesota and doctorate in microbiology from the University of Pittsburgh. She held postdoctoral fellowships at the Max Planck Institute in Tübingen, Germany, Princeton University in Princeton, New Jersey, and Sloan Kettering Institute for Cancer Research in New York City. She is a diplomat of the American Board of Toxicology, certified in general toxicology.

Jane C. Barton

Jane C. Barton is a consultant to public and private organizations in environmental management, domestic and international science and public policy. After a career of 25 years covering a range of sustainable development issues, she retired in 2006 as Chief, North American Smog Programs, Environment Canada where she was responsible for managing Canada's efforts pursuant to the bilateral Canada-U.S. Air Quality Agreement and for providing strategic advice on science, policy and program efforts that would support air quality improvements across North America. Major achievements during her career in the public service were the successful negotiation in 2000 of an annex to the treaty between Canada and the United States on air quality to address transboundary ozone and the completion of a U.S.-Canada feasibility study of emission caps and cross-border trading for emissions of sulphur dioxide and nitrogen oxides.

She is a member of the Air and Waste Management Association (AWMA) Editorial Advisory Committee for *EM: the Magazine for Environmental Managers*. Ms. Barton completed her undergraduate B.A. Honors degree in Geography at Carleton University, Ottawa, Canada and her

Masters of Science degree in Regional and Urban Planning Studies at the London School of Economics, London, United Kingdom.

Agustin García

Agustin García is a researcher of Centro de Ciencias de la Atmósfera-UNAM (Atmospheric Sciences Center-UNAM), focusing on issues related to air quality modeling and atmospheric risk assessment. He is also the graduate program coordinator at CCA-UNAM and professor of environmental engineering at Chemistry School UNAM. He has lectured on meteorology and air quality interactions, air toxic risk assessment, air quality modeling and environmental engineering. He is a qualified expert in environmental protection by the national association of chemical engineers and chemist (CONIQQ).

He is conducting research on the influence of climate change on air quality for the central part of Mexico, air quality forecasting, and evaluation of benefits due to the application of new technologies in the Megacity of Mexico.

Dr. García received his undergraduate degree in chemical engineering from the Chemistry school, a master degree from the graduate school of engineering, and a doctorate in Earth Sciences from Universidad Nacional Autonoma de México (UNAM). He held a postdoctoral stay at Massachusetts Institute of Technology and research stays in UCLA, U.S. and IMK-IFU, Germany.

John Kinsman

John Kinsman is Senior Director, Environment at the Edison Electric Institute (EEI) in Washington, D.C. Mr. Kinsman's career has spanned 28 years, including the last 21 years at EEI. EEI is the trade association for U.S. shareholder-owned electric companies plus international affiliates and industry associates worldwide. He addresses issues such as ozone, particulate matter, sulfur dioxide, nitrogen oxides, acid rain, visibility, and greenhouse gases in policy, regulatory, legislative, and communications contexts. He has administered EEI's air quality committee since its inception in 1997 and two power industry programs to manage CO₂ via forestry projects – UtiliTree Carbon Company (established in 1995) and PowerTree Carbon Company (established in 2003). His degrees in environmental science are from the University of Virginia and George Mason University. He has served on the editorial boards of four science policy journals and an advisory committee on state/county air quality planning in the Metropolitan Washington area.

Edward W. Piché

Edward W. Piché is currently retired from the Ministry of the Environment, Ontario, Canada after a distinguished career of service spanning 33 years. Previous to retiring he held the position of Senior Science Advisor to the Assistant Deputy Minister for Environmental Sciences and Standards, Ministry of the Environment, Ontario. Prior to accepting this one-of-a-kind position, he had served as a Director of various branches with the Ministry of the Environment for over 22 years. In his last position he was responsible for providing advice on a range of

issues including: accelerated, human induced climate change, emerging substances of concern, integrated place based monitoring and cumulative impacts modelling. In previous senior leadership positions he was responsible for Air Quality and Meteorology monitoring, including the SMOG Alert and Advisories Programs, the new Health Based Air Quality Index, all major Bio-monitoring Programs, including the publication of the Biannual Fish Guide, all Great Lakes Monitoring activities, including Canada Ontario Agreement initiatives, Emissions tracking and Reporting, and Modelling and Emergency Response capabilities. In all 36 Provincial ambient monitoring programs.

In 2004, Mr. Piché was recognized by the Environmental Commissioner of Ontario for a lifetime dedicated to ambient monitoring in Ontario. He was a member of the International Joint Commissions Air Quality Advisory Board for over 15 years.

Mr. Piché is currently working as a self-employed environmental consultant, located in Richmond Hill, Ontario, Canada.

Richard Poirot

Richard Poirot received a B.A. from Dartmouth College in 1972. He has worked as an Air Quality Planner for the Vermont Department of Environmental Conservation for the past 30 years. He has served on a range of regional, national and international committees, workgroups and advisory boards focused on understanding sources, transformation, transport, deposition and/or effects of air pollution on human health, environment and welfare. On a regional scale, he's been a member and past chair of Committees on Acid Deposition and on Ambient Monitoring and Assessment for the Northeast States for Coordinated Air Use Management (NESCAUM), and co-chairs the Monitoring and Data Analysis Committee for the Mid-Atlantic Northeast Visibility Union (MANE-VU) Regional Planning Organization (RPO).

Nationally, Rich serves on the Steering Committees for the Interagency Monitoring of Protected Visual Environments (IMPROVE) program, and for the Visibility Information Exchange Web System (VIEWS) data archive system. He co-chairs the national inter-RPO Monitoring and Data Analysis Committee, and was a former member of the EPA Acid Rain Advisory Committee, the Data Analysis Workgroup of the Ozone Transport Assessment Group (OTAG), and the Science and Technical Support Workgroup of the EPA Federal Advisory Committee on Ozone, Fine Particles and Regional Haze (OPRAH). He recently completed a 6-year term as a member of the EPA Clean Air Scientific Advisory Committee (CASAC), during which he served on the CASAC National Ambient Air Quality Standards (NAAQS) review panels for Particulate Matter, Ozone, and Lead. He is a former co-chair and current member of the CASAC Ambient Air Monitoring and Methods Subcommittee (AAMMS), and also currently serves on the CASAC panels for Secondary SO_x and NO_x NAAQS, and the current PM NAAQS review.

Internationally, Rich has been a member of the Northeast Regional Air Quality Committee (NERAQC), the Acid Rain and Atmospheric Data Exchange Committees of the Conference of New England Governors and Eastern Canadian Premiers (NEG/ECP), and is a member of the US/Canada Air Quality Committee, Subcommittee on Scientific Cooperation.

EXECUTIVE SUMMARY

The NARSTO Executive Assembly directed the Executive Steering Committee and the Management Coordinator's Office to organize a Review Panel to assess the past and present performance in meeting the goals of the NARSTO Charter and to make recommendations on NARSTO's future operations. The six-member Review Panel, representing various constituencies within the NARSTO organization, was charged to prepare a report to:

1. Assess the quality and value to its constituencies of past and current NARSTO activities;
2. Assess NARSTO's distinctive capabilities and their value to NARSTO's constituencies;
3. Assess the future need for and value of NARSTO and the kinds of perspective, products, and services it can provide; and
4. Provide a recommendation to the NARSTO Executive Assembly as to (a) whether or not NARSTO should continue to operate and (b) if so, what changes or improvements are needed to increase its value.

The Review Panel finds that past and current NARSTO activities and products are highly valued by NARSTO constituents, both in terms of advancing the scientific understanding of atmospheric pollutants, and communicating that understanding to support enlightened air quality management decisions in Canada, Mexico, and the United States. NARSTO's distinctive capabilities to link federal, state and provincial government agencies across the three nations with counterparts from industry and academia and its flexible, cost-efficient management structure are unique and valuable attributes that would be difficult to replace by other institutional mechanisms.

Although NARSTO participants express a wide range of views on which past activities and future research areas are most important, there is enthusiastic consensus that NARSTO can play a valuable future role in assessing emerging North American air quality issues, such as the interface of air quality and climate change, while continuing to shed light on the complex, persistent air quality problems like tropospheric ozone and particulate matter.

The NARSTO Review Panel recommends to the NARSTO Executive Assembly that NARSTO continue to operate. The Review Panel believes that much additional valuable work can be accomplished by an organization of this nature. However, for NARSTO to continue to operate effectively, several important changes are recommended in its operations and its relationships to the three governments whose scientific representatives originally signed the NARSTO Charter:

- Formalize institutional support for NARSTO among major participating organizations;
- Increase participation by policy-makers to help identify key science/policy questions;
- Strengthen NARSTO's strategic workplanning processes;
- Assure stable and equitably distributed NARSTO funding for core activities; and
- Review and assess NARSTO's organizational structure and partnerships.

RESUMEN EJECUTIVO

La Asamblea Ejecutiva de NARSTO encargó al Comité Directivo y Ejecutivo y a la oficina del Coordinador de Gestión la organización de un Panel de Revisión para evaluar el rendimiento pasado y presente en el cumplimiento de los objetivos en la Carta Constitutiva de NARSTO y formular recomendaciones sobre el futuro de las operaciones de NARSTO. Al Panel de Revisión constituido por seis miembros, y que representa diversos grupos dentro de la organización NARSTO, se le encargó preparar un informe para:

1. Evaluar la calidad y el valor que tienen las actividades pasadas y actuales de NARSTO para los miembros que la constituyen;
2. Evaluar las capacidades distintivas de NARSTO y el valor que tienen para quienes constituyen NARSTO;
3. Evaluar el valor y la necesidad de NARSTO y los tipos de perspectiva, productos y servicios que puede proporcionar; y
4. Proporcionar una recomendación a la Asamblea Ejecutiva de NARSTO sobre (a) la continuación del funcionamiento o no de la operaciones de NARSTO (b) en caso afirmativo indicar, qué cambios o mejoras son necesarios para incrementar su valor.

El Panel de Revisión encontró que las actividades y productos de NARSTO pasados y presentes son altamente valorados por los que constituyen NARSTO, tanto en términos del avance de la comprensión de los contaminantes atmosféricos, y comunicando esa comprensión para apoyar las decisiones en la administración de la calidad del aire en Canadá, Estados Unidos, y México. Entre las capacidades distintivas de NARSTO esta el ligar los organismos federales, estatales y municipales en los tres países con sus homólogos en la industria y academia, y su estructura administrativa flexible y costo-eficiente son únicas y son atributos valiosos que serían difíciles de reemplazar por otros mecanismos institucionales.

Aunque los participantes de NARSTO expresaron una amplia gama de puntos de vista de las actividades pasadas y las áreas de investigación futuras que son más importantes, existe un consenso entusiasta de que NARSTO puede desempeñar un papel valioso en el futuro para evaluar las cuestiones emergentes de calidad del aire en América del Norte, tales como la interfaz de la calidad del aire y el cambio climático, sin dejar de explicar los problemas complejos y persistentes de calidad del aire como el ozono troposférico y las partículas.

El Panel de Revisión de NARSTO recomienda a la Asamblea Ejecutiva de NARSTO que NARSTO continúe operando. El Panel de Revisión considera que mucho más trabajo de valor se puede realizar por una organización de esta naturaleza. Sin embargo para que NARSTO pueda seguir funcionando de manera eficaz, varios cambios importantes se recomiendan en sus operaciones y en sus relaciones con los tres gobiernos cuyos representantes científicos firmaron originalmente la Carta Constitutiva de NARSTO:

- Formalizar el apoyo institucional de NARSTO entre las Organizaciones Participantes Mayores;
- Aumentar la participación de tomadores de decisiones para ayudar a identificar las preguntas científicas/políticas claves;

- Fortalecer el Trabajo de Planificación Estratégica de NARSTO;
- Asegurar una distribución estable y equitativamente distribuida del financiamiento de las actividades básicas de NARSTO; y
- Revisión y evaluación de la estructura organizativa de NARSTO y de quienes constituyen.

SOMMAIRE EXÉCUTIF

L'assemblée exécutive de la Stratégie nord-américaine de recherche sur l'ozone troposphérique (NARSTO) a demandé au comité exécutif de direction et au bureau de coordination de la gestion de mettre sur pied un comité de révision qui évaluera la capacité passée et actuelle de la stratégie à atteindre les objectifs de sa charte, et formulera des recommandations sur les opérations futures de la NARSTO. Les six membres du comité de révision, représentant diverses structures au sein de l'organisme, ont été priés de faire rapport aux fins suivantes:

1. Évaluer la qualité et la valeur pour les structures de l'organisme des activités passées et actuelles de la NARSTO;
2. Évaluer les capacités distinctives de la NARSTO et leur valeur pour les structures;
3. Établir les besoins et valeurs futurs de la NARSTO, ainsi que les types de perspectives, produits et services qu'elle peut offrir; et
4. Formuler une recommandation à l'assemblée exécutive dans le but d'établir a) si la NARSTO devrait continuer ses activités et, b) dans l'affirmative, quels changements ou améliorations permettraient d'accroître sa valeur.

Le comité de révision en est venu à la conclusion que les activités et produits passés et actuels de la NARSTO sont très bien perçus par les différentes structures, en terme de l'avancement des connaissances scientifiques sur les polluants atmosphériques et du partage de ces connaissances visant à appuyer la prise de décisions éclairées en matière de gestion de la qualité de l'air au Canada, au Mexique et aux États-Unis. Les capacités distinctives de la NARSTO à établir des liens entre les organismes gouvernementaux fédéraux, des États et des provinces des trois pays et l'industrie et le milieu universitaire, de même que sa structure de gestion flexible et économique, sont des caractéristiques uniques et précieuses qu'il serait difficile de remplacer par d'autres mécanismes institutionnels. Les participants de la NARSTO ont exprimé des opinions très diversifiées quant aux importances relatives des activités passées et des domaines de recherche futurs. Il existe cependant un consensus sur le fait que la NARSTO pourrait jouer un rôle important dans l'évaluation des nouvelles questions de qualité de l'air en Amérique du Nord, telles que l'interface de la qualité de l'air et des changements climatiques, tout en continuant à faire la lumière sur les problèmes complexes et persistants de la qualité de l'air comme l'ozone troposphérique et les particules. Le comité de révision recommande donc à l'assemblée exécutive que la NARSTO poursuive ses activités. Il est d'avis qu'un organisme de cette nature peut encore apporter des contributions précieuses. Cependant, pour que la NARSTO continue de fonctionner d'une manière efficace, le comité de révision recommande que soient apportés plusieurs changements importants à ses opérations et à ses relations avec les gouvernements des trois pays dont les représentants scientifiques ont au départ signé la charte :

- Officialiser un appui institutionnel à la NARSTO au sein des principaux organismes participants;
- Accroître la participation des décideurs pour aider à identifier les principales questions de science et de politiques;
- Renforcer le processus stratégique de planification du travail de la NARSTO;

- Assurer le financement équilibré et équitable aux activités fondamentales de la NARSTO; et
- Examiner et évaluer la structure organisationnelle et les partenariats de la NARSTO.

SECTION I. INTRODUCTION

NARSTO was established February 13, 1995, through a Charter¹ signed by scientific representatives of Canada, the United States, and Mexico. It was originally created to address the tropospheric ozone issues that had resisted resolution in the United States since the 1960s and was a growing concern in neighboring jurisdictions. Recognizing the transboundary nature of the issue and the interest of the regulated community in achieving effective solutions, NARSTO's unique three-country public/private partnership has paved the way for creating policy-relevant scientific research and assessment of air pollution as the basis for potential strategies for local and regional air-pollution management.

Since its inception, NARSTO has been primarily directed and supported by senior scientists from participating organizations. The topics NARSTO has addressed have been of such interest and importance to the scientific community that it was able to attract talented scientists from government, academia, and industry to work on projects and activities and to provide financial support. As these individuals have moved on or their responsibilities have changed, institutional memory, support, or commitment to NARSTO has changed and, in some cases, disappeared. Added to these changes is that fact that, when the NARSTO Charter was signed by the "Founders", it carried with it no binding agreement or funding formula. The result has been that there is little balance in the way that NARSTO has been supported among the three participating countries, and among participating agencies and industry organizations within these countries.

The NARSTO review was called for to respond to questions from NARSTO members regarding the value of NARSTO to its participants and what changes, if any, might be considered to improve its focus, structure or function.

SECTION II. CHARGE TO THE NARSTO REVIEW PANEL

The NARSTO Executive Assembly, which is the governing body of NARSTO, directed the NARSTO Executive Steering Committee and the NARSTO Management Coordinator² to organize a Review Panel to undertake the review of NARSTO. The six-member Review Panel, representing the various constituencies within the NARSTO organization, was charged to prepare a report that would do the following:

1. Assess the quality and value to its constituencies of past and current NARSTO activities;
2. Assess NARSTO's distinctive capabilities and their value to NARSTO's constituencies;
3. Assess the future need for and value of NARSTO and the kinds of perspective, products, and services it can provide; and

¹ The governing document of NARSTO is its Charter (<http://www.narsto.org/section.src?SID=3>), which was signed February 13, 1995 by representatives of Canada, the United States, and Mexico. The Charter was revised January 19, 1999 to reflect expansion of NARSTO's scope to include air quality issues other than ozone.

²The NARSTO Executive Assembly is the annual general meeting of NARSTO members. The Executive Assembly reviews the activities of the past year, discusses future NARSTO projects, and provides direction to the NARSTO Executive Steering Committee and the NARSTO Management Coordinator. (See <http://www.narsto.org>)

4. Provide a recommendation to the NARSTO Executive Assembly as to (a) whether or not NARSTO should continue to operate and (b) if so, what changes or improvements are needed to increase its value.

The Review Panel was not requested to address the current or past performance of staff in NARSTO management.

SECTION III. NARSTO: THE ORGANIZATIONAL SCOPE AND NATURE

An overview of NARSTO's organizational structure, financial support and its major products and activities is fundamental to a review and assessment of its value and future. The NARSTO partnership is a non-binding, tri-national public/private alliance, open to science and regulatory agencies, regulated industries, academic institutions, environmental non-governmental organizations and public interests groups in Canada, the United States and Mexico.

According to the NARSTO Charter, the "NARSTO organization will plan and coordinate independently sponsored programs that result in projects and tasks designed to identify and resolve policy-relevant science questions related to (a) anthropogenic and biogenic air-pollution sources and emissions, (b) the complex physical and chemical processes affecting the accumulation of pollutants in the troposphere, (c) the potential of certain pollutants to react and generate oxidants and fine particles in the troposphere, (d) the development, inter-comparison and application of atmospheric models, (e) the development of monitoring studies and methodologies needed to assess emission control effectiveness for selected air pollutants and their precursors, and (f) the attainment of the national air quality goals and standards established by each member nation." (See <http://www.narsto.org/files/files/NarstoCharter.pdf>). NARSTO also recognizes that the effects of climate change and the management of greenhouse gas emissions will become a factor in air quality management.

NARSTO products have included the development of four comprehensive science assessments: An Assessment of Tropospheric Ozone Pollution – A North American Perspective (2000); Particulate Matter Science For Policy Makers (2004); Improving Emission Inventories for Effective Air Quality Management Across North America (2005); and an assessment of the technical challenges of implementing a multi-pollutant approach to air quality management, which is to be published in 2009. A number of smaller focused reports have also been prepared including for example, the report of the Workshop on Aerosol Modeling and Process Evaluation (2007) and the reports of the Reactivity Research Work Group. Annual and special meetings and workshops have been held on a wide range of issues and topics. These meetings and workshops have facilitated the transfer of knowledge and expertise as well as providing invaluable networking opportunities for participants. Communication, outreach and information dissemination are also provided by the NARSTO website, newsletters, and data archive.

NARSTO's core activities – the Management Coordinator's Office, the Quality Systems Science Center, and the Associate Management Coordinator – have been funded by DOE's Office of Biological and Environmental Research (OBER) and EPA's National Exposure Research

Laboratory (NERL). For NARSTO project activities, funding is secured on a project-specific basis. NARSTO's workload can vary considerably from year to year, depending on what project or projects it is asked to undertake. The additional costs associated with specific projects are covered by ad hoc contributions to the NARSTO "infrastructure budget," or by direct funding by NARSTO members. Details of NARSTO's funding support can be found in Appendix I-a.

SECTION IV. METHODOLOGY FOR THE REVIEW

The Review Panel took a three pronged approach for its review: direct interviews with senior program personnel; a broader electronic-based canvassing of interested and involved people from academia, governments and industry; and independent research. For the interviews and questionnaire, individuals from Canada, the United States, and Mexico were engaged. The Panel undertook research of its own to ascertain how often NARSTO's products appear to have contributed to air quality science and policy in Canada, the United States, and Mexico.

To supplement the interviews and questionnaire, the Review Panel also requested that Jeremy Hales, the former NARSTO Management Coordinator, provide his insights. (See Appendix I-b.)

1. INTERVIEWS

The Review Panel selected 18 individuals from 10 organizations to be interviewed. The individuals were chosen on the basis of their background, interest, experience and responsibility. Their organizations³ represented a wide range of government and nongovernment agencies in Canada, the United States, and Mexico. Those interviewed were advised of the report objectives via mail and through follow-up phone calls. The interviews began with an option to provide remarks, followed by a set of seven interrogative statements as illustrated in Appendix II-a. The list of the interviewees and summaries of their responses are appended in Appendices II-b to II-g.

2. QUESTIONNAIRE

The electronic questionnaire, consisting of 19 questions, focused on gathering data from 53 interested individuals in Canada, the United States, and Mexico. The questionnaire was administered by ORISE⁴ and was available in English and Spanish. An overall summary of the responses is available in Appendix III-a. For those responses that could be quantified, a summary is provided in Appendix III-b1. Where the questionnaire requested comments and advice, the responses provided are found in Appendices III-b2 to III-b10.

³ National Institute of Ecology (Mexico), Environment Canada, National Academy of Sciences (U.S.), Environmental Protection Agency (U.S.), Department of Energy (U.S.), National Oceanic and Atmospheric Administration (U.S.), Oak Ridge National Laboratory (U.S.), Mid-Atlantic Regional Air Management Association (U.S.); American Petroleum Institute, and Electric Power Research Institute (U.S.)

⁴ (ORISE) The **Oak Ridge Institute for Science and Education** is a U.S. Department of Energy institute focusing on scientific initiatives to research health risks from occupational hazards, assess environmental cleanup, respond to radiation medical emergencies, support national security and emergency preparedness, and educate the next generation of scientists.

SECTION V. ANALYSIS AND DISCUSSION

CHARGE # 1. ASSESS THE QUALITY AND VALUE TO ITS CONSTITUENCIES OF PAST AND CURRENT NARSTO ACTIVITIES

In addition to the comprehensive science assessments in progress on multi-pollutant air quality management and completed on tropospheric ozone, particulate matter and emission inventories, NARSTO has produced multiple technical reports from focused scientific workgroups and workshops. Further, NARSTO has organized and supported annual Executive Assemblies and periodic conferences, science meetings and workshops. NARSTO forums have provided international and inter-institutional collaboration and networking opportunities for its participants, while the NARSTO website broadly distributes the resulting documents and data to many diverse user groups throughout North America and beyond. NARSTO has coordinated field research campaigns, established a Quality Systems Science Center and permanent data archive, established a Reactivity Research Work Group to address the potential for regulating emissions of Volatile Organic Compounds (VOC) on the basis of chemical reactivity, undertaken atmospheric model evaluations and comparisons, held regional emissions inventory workshops, addressed measurement methodologies and improved quality assurance procedures.

NARSTO's structure has been sufficiently flexible to allow it to accommodate different government and public/ private interactions found in the three North American nations. The United States has had both high level federal government and industry participation. Canada's involvement has been primarily through scientific collaboration from federal government scientists – with limited participation from policy level government or private sector groups. Mexico's involvement, like Canada's, has been primarily through scientific collaboration with researchers in both academia and government, focusing on those areas where Mexican priorities correspond with those of the NARSTO work..

Appendix II-c summarizes the views of those interviewed with respect to the quality and value to its constituencies of past and current NARSTO activities. Participants involved with NARSTO commented favorably on the opportunities for collaboration with colleagues from other governments and the private sector as well as other countries. For instance, respondents highlighted NARSTO's valuable assistance in supporting intensive field studies such as:

- NARSTO-Northeast (See Appendix IV-d) and the Supersites program in the United States (See Appendix IV-f),
- The paired border studies: 1995 NARSTO-Canada East and NARSTO-Northeast studies, Canada Pacific 2001 and U.S. Pacific Northwest 2001 field studies, and
- 1997 Mexico City studies, the more recent Megacity Initiative: Local And Global Research Observations (MILAGRO), and field campaigns. (See Appendix IV-g.)

Most of those interviewed and surveyed also pointed out that NARSTO assessments and reports were useful in planning future research agendas and communicating to management on issues of current and emerging importance (see Appendices II-c, III-b3, and III-b4). NARSTO's substantial contributions to the advancement of atmospheric science are also well-documented in the scientific peer reviewed literature. A survey of scientific journal publications by the Review

Panel revealed NARSTO references in more than 500 publications between 1997 and 2009, distributed among more than 100 different scientific journals. (See Appendix IV-b.)

The NARSTO Emission Inventory Assessment has resulted in tangible changes in the way inventories are developed. For instance, the assessment has resulted in better emission inventory compatibility and comparability in North America. Activities are underway to merge Canadian, Mexican, and U.S. emission modeling datasets such that applications to utilize the data can do so without experiencing incompatibilities in the data across political boundaries. (See Appendix IV-c.)

NARSTO assessments, field studies, workshops, workgroups, reports and other activities are also frequently cited to support various government reports and regulatory actions at the federal, state/provincial and international levels. For example, NARSTO assessment results were cited in the most recent U.S. EPA Criteria Documents and Staff Papers for Ozone and Particulate Matter. NARSTO Assessments have also been cited in support of EPA regulations, such as: the Clean Air Interstate Rule (CAIR), New Source Review Program for PM_{2.5}, Clean Air PM_{2.5} Implementation Rule and Regional Haze Regulations. NARSTO Reactivity Research Work Group (RRWG) activities (See Appendix IV-e) and findings were cited in EPA Guidance on Control of VOCs in Ozone State Implementation Plans (SIP), in approving California SIP revisions employing reactivity-based regulations of aerosol coatings, and in subsequently issuing National (reactivity-based) VOC Emission Standards for Aerosol Coatings. State and regional air quality management groups in the United States have also relied on NARSTO products, which have been cited by the National Association of Clean Air Administrators (NACAA, formerly STAPPA/ALAPCO), Ozone Transport Assessment Group (OTAG), Ozone Transport Commission (OTC), Regional (haze) Planning Organizations (RPOs) and in individual State planning, research and regulatory activities. (See Appendix IV-a.)

In Mexico, where NARSTO collaboration has been especially useful in improving emissions inventory development, NARSTO research and reports have been cited in the Mexican government reports “Inventario Nacional de Emisiones de México, 1999”, in the Air Quality Information Catalogue for the Mexicali-Imperial Valley Border Region, and in the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) “Manual para el curso de elaboración y uso de inventarios de emisiones” (Manual for the development and use of emissions inventories).

In Canada, the NARSTO Ozone Assessment provided support for the addition of ozone and its precursors to the list of “Toxic Substances” listed in the 1999 *Canadian Environmental Protection Act*. NARSTO assessments and reports have also been used in the Canadian Council of Ministers of the Environment review of Canada-Wide Standards for Ozone and PM and for review of Canadian air quality monitoring networks. The Province of Ontario has cited NARSTO activities and reports in developing “Proposed Performance Indicators for Ontario’s Anti-Smog Action Plan” and in preparing legal submissions to the U.S. EPA on transboundary air pollution. The Canada-U.S. Air Quality Committee relied heavily on the NARSTO PM Assessment in developing the “Canada-U.S. Transboundary Particulate Matter Science Assessment”, which was the basis of decisions by the United States and Canada to begin to negotiate a new annex to the 1991 U.S.-Canada Air Quality Agreement to address transboundary

PM. The bilateral Air Quality Committee has also cited NARSTO activities and assessments in each of its biennial progress reports on the Air Quality Agreement from 1998 through 2008.

Overall, NARSTO has proven to be a successful institution for not only advancing the scientific understanding of tropospheric air pollutants in North America, but also for communicating this understanding in ways that have been utilized in support of public policy decisions at many levels of government in all three countries. Among respondents to the NARSTO questionnaire and interviews, the NARSTO assessments were most frequently rated as the most valuable NARSTO contributions. However NARSTO meetings, workgroups and workshops were also rated very highly, indicating that participants have valued the NARSTO process as well as its products.

Respondents expressed strong support for NARSTO’s past activities. The ozone and PM assessment documents, and the collaborative process through which those assessments were developed, were uniformly acknowledged as timely and valuable accomplishments across all countries and by all NARSTO participants and user groups. The value of NARSTO contacts, workgroups and workshops, and the coordination and refinement of a trilateral atmospheric science research agenda were also often mentioned as highly beneficial. Many also expressed the view that the efforts expended on emission inventory reports and workshops would prove to be beneficial in the future. Indeed, Table 1, which summarizes the results of the Questionnaire, illustrates that each of the many different and diverse NARSTO activities was considered to be the organization’s most valuable contribution by one or more of the respondents.

Table 1. Questionnaire Responses: Ranked Value of NARSTO Activities (See Appendix III-b1.)

NARSTO Activity	Number Responding	Average Rank	Highest Rank	Lowest Rank
Assessments	44	1.8	1	5
Reports	37	3.5	1	11
Meetings/Workshops	38	3.7	1	9
Networking Opportunities	31	4.6	1	10
Regional Emission Inventory Workshops	23	5.1	1	11
Data Archive	30	5.3	1	11
Atmospheric Model Inter-comparisons	26	5.3	2	10
Website	28	5.8	1	9
Executive Assemblies	24	6.2	2	11
Measurement Methodologies	23	6.2	2	10
Reactivity Work Group	15	6.5	1	11

Some concerns were expressed regarding recent NARSTO activities. (See Appendices II-g, III-b5, III-b9, and III-b10) For example, NARSTO activities may have become scattered and the time may have come to redirect focus and energy back toward the original ozone and PM issues. Others commented that recent NARSTO initiatives did not seem to be directly responsive to emerging management and policy needs. Current budget constraints and future funding

uncertainties are an additional challenge for both government and private sector groups in all three countries. A commenter suggested that one of NARSTO's greatest initial strengths was in its empowerment of individuals with high energy, enthusiasm and scientific expertise to reach out to and collaborate with like-minded colleagues across institutional and international borders. Over time, however, and especially given current budgetary uncertainties, this initial "science-first" strength has become a weakness absent the parallel support and direction of responsible, policy-level agency managers.

NARSTO's initial intensive focus on tropospheric ozone and particulate matter as well as its flexibility to take on new issues are both key aspects of the organization's past success. As NARSTO continues to evolve, the point was made that it should periodically revisit the ozone and PM issues upon which it was founded. As NARSTO focuses on these persistent air quality problems as well as on emerging and future science/policy questions, several of those interviewed reflected that NARSTO would benefit greatly from more direct participation from policy-level decision-makers across its many government and private sector institutions and in all three countries.

CHARGE #2. ASSESS NARSTO'S DISTINCTIVE CAPABILITIES AND THEIR VALUE TO NARSTO'S CONSTITUENCIES

Lower ambient air pollutant concentrations are the result of effective air emissions abatement actions – actions which are often significantly influenced by national and international partnerships. NARSTO is a successful example of just such a partnership with numerous valuable and high quality activities and products.

Appendix II-d summarizes the views of those interviewed in relation to NARSTO's distinctive capabilities and their value to NARSTO's constituencies. Many of the interviewees and questionnaire respondents pointed out that NARSTO's expertise is unique for a number of reasons. First, NARSTO's trilateral construct has provided the basis for focussing multinational research activities on the key North American policy relevant science questions by providing an authoritative review of research priorities. The trilateral work on analytical methods, data formats, emission inventories and modelling intercomparisons has also set the stage for continental wide conclusions regarding air quality. In the case of reactivity research and in terms of Canada-U.S. transboundary PM, policy decisions in more than one country have been directly influenced by NARSTO's transboundary work.

Second, NARSTO's make-up includes not only representatives of federal governments, but also experts from industry and academia and participants from state, provincial and local governments. This unique dimension of NARSTO broadens the perspective on research priorities, bridges the gaps among different viewpoints and provides fruitful opportunities to collaborate with groups and individuals outside of the usual institutional, disciplinary, and geographic spheres. The value to NARSTO members resulting from such a harmonious approach cannot be overstated. The fact that industry participation in NARSTO has shrunk to only U.S. participation is, however, an issue.

Third, the NARSTO organization is streamlined, non-bureaucratic, flexible, transparent, and encourages active engagement of the participants. This structure allows NARSTO to address issues difficult for other organizations to deal with because, for instance, an issue may be cross-sectoral or international in scope or the investigation calls for the participation of people from a wide range of technical expertise. NARSTO, as a “community of interest”, brings in contributors from many agencies including EPA, DOE, NOAA, USDA, DOI, DOT, NASA in the U.S., Environment Canada in Canada, and SEMARNAT in Mexico. A review of the organizational structure is incorporated in the Insights on NARSTO by Jeremy Hales in Appendix I-b.

Other programs share some similar characteristics with NARSTO.

- The National Academy of Sciences (NAS) can cover some of the same U.S. scientific issues as NARSTO but requires process and structure that is more time consuming and costly.
- The North American Free Trade Agreement Council for Environmental Co-operation (CEC) is another organization that is similar to NARSTO in that it too is trilateral. The CEC is a large organization chaired by the political leaders of the federal environment departments in the three countries. Unlike NARSTO, however, the CEC is focussed on a broad scope of North American issues and is not equipped to take on the in-depth science work that has been the traditional bailiwick of NARSTO.
- The European Union ACCENT is an organization that incorporates certain characteristics that may be of interest to NARSTO (http://www.accent-network.org/farcry_accent/). The overall goals of ACCENT are to promote a common European strategy for research on atmospheric composition change, to develop and maintain durable means of communication and collaboration within the European scientific community, to facilitate this research and to optimize two-way interactions with policy-makers and the general public.

Fourth, NARSTO has established a data archive site to house data from monitoring sites such as the Supersites (See Appendix IV-f) and from field studies that it has supported. The data archive, which contains between 100 and 125 data sets with over 1000 files in standardized form/formats, has been useful for researchers in North America but it is accessible throughout the world.

In summary, responses by questionnaire respondents and by interviewees and the research by the Review Panel have all demonstrated that NARSTO’s efficient and effective structure would be difficult or impossible to recreate and that there is no similar source for policy makers of transboundary air quality scientific information.

CHARGE # 3. ASSESS THE FUTURE NEED FOR AND VALUE OF NARSTO AND THE KINDS OF PERSPECTIVE, PRODUCTS, AND SERVICES IT CAN PROVIDE

Most interviewees expressed the view that there is a future need and value for NARSTO. (See Appendix II-e.) As is apparent in Appendix III-b8, a substantial majority of questionnaire

respondents suggested that, if NARSTO were to cease to exist, current coordination and communication between the three countries would suffer as would existing cooperation between public and private sectors. Coordination of cost-effective research and assessment also would suffer.

Questionnaire respondents and interviewees identified many important future scientific questions or issues, and virtually all thought NARSTO could assist in responding to such questions or needs. (See Appendix IV-h for additional details⁵.)

Figure 1 displays the issues of interest as suggested by questionnaire respondents and interviewees.

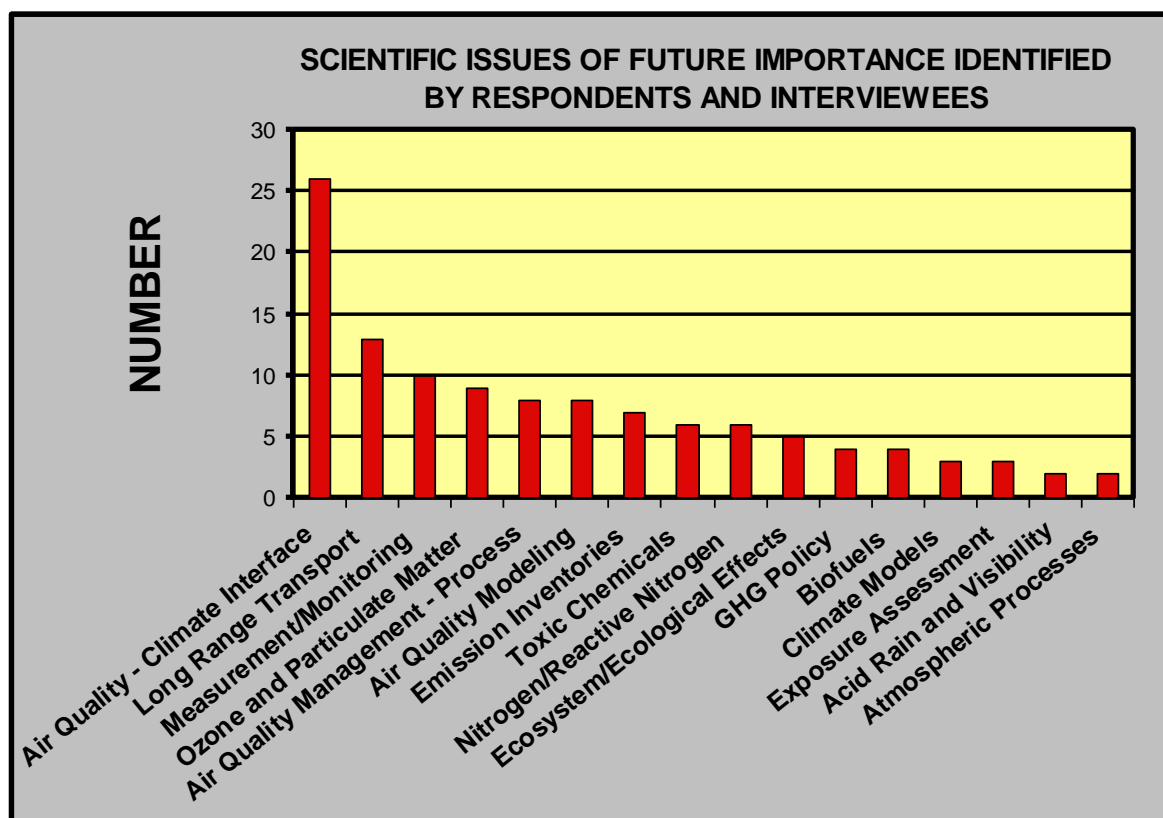


Figure 1. Scientific Issues of Future Importance Identified by Respondents and Interviewees

It is clear that the interaction between air quality and climate change is thought to be one of the most important future issues, although the Review Panel was told by several respondents that NARSTO should maintain its air quality focus. Many linkages between air quality and climate change were pointed out including scientific and management questions, policy issues, modeling interactions, the link to carbon and nitrogen, and issues related to biofuels and black carbon. Also rating high as a future issue is transboundary long-range transport and transcontinental transport. The relationship of transboundary transport to background levels and attainability of

⁵ Questionnaire respondents were allowed to identify up to three issues or questions of future importance. Suggestions from interviewees who did not complete the questionnaire are integrated into the results.

standards was identified as an issue with regard to ozone, particulate matter, and some toxic air pollutants.

Other issues raised by multiple stakeholders are noted below:

- Air quality management practices ranked highly. Many different ideas of important activities were identified, such as improved compilations of available technological control options, better assessment tools, and multi-pollutant management. Related are the issues of air quality modeling, measurement, monitoring and emissions inventories, all of which were judged as important by numerous respondents who noted that continued improvements in these areas are needed.
- Ozone and particulate matter science and management remain as key issues. Related issues identified by numerous respondents are tied to future standard setting, including the effects thresholds, background levels, and attainability.
- Other issues raised by numerous respondents included:
 - ✓ Toxic air pollutants.
 - ✓ Organic carbon (related to climate change and particulate matter).
 - ✓ Nitrogen, especially ammonia/reactive species, which is growing in importance as other emissions are further reduced.
 - ✓ Biofuels, related to air pollution and climate change.
 - ✓ Ecosystem/ecological effects.

CHARGE # 4. PROVIDE A RECOMMENDATION TO THE NARSTO EXECUTIVE ASSEMBLY AS TO (A) WHETHER OR NOT NARSTO SHOULD CONTINUE TO OPERATE AND (B) IF SO, WHAT CHANGES OR IMPROVEMENTS ARE NEEDED TO INCREASE ITS VALUE.

Throughout the questionnaire and interview responses, several points were made often in relation to changes or improvements that NARSTO could undertake to increase its value.

NARSTO's funding was addressed by many of those surveyed or interviewed as an area for improvement. Many respondents acknowledged the organization's considerable productivity despite its small cost. The current model allows members unable to commit to a fixed annual contribution to fund NARSTO activities they see as important when they have the resources to do so. However, the burden of funding NARSTO core activities falls upon two U.S. agencies, and especially upon DOE's OBER, which has provided the bulk of NARSTO's financial support over the years. This dependence upon OBER is a source of instability in NARSTO's funding model and the issue of how to replace that funding, should it decrease or disappear, was considered a very difficult problem by respondents. Regardless, many respondents believed that sustained funding for the organization is essential and that a more equitable distribution of core funding support from among NARSTO participants was desirable. Respondents acknowledged that NARSTO's flexible structure has allowed it to take excellent advantage of various ad hoc funding and in-kind support opportunities in the past, but recognized that this leveraging is only possible if a level of stable core funding support is available. While no respondent made a clear offer to fund the organization, suggestions were made that Canada and Mexico should expand their financial contribution to NARSTO, even that there could be an assessed financial contribution for each NARSTO country.

In addition to an improved funding support system, it was also recommended that participating NARSTO agencies and institutions encourage an increased degree of participation from policy-level managers. The view was expressed that it is critical to have input from both scientists and policy makers to articulate the most important emerging “policy-relevant science” questions and to develop efficient coordinated strategies to answer those questions.

A number of respondents suggested that NARSTO needs greater visibility through enhanced outreach and communications. One individual even suggested that NARSTO create a blog. Connected to this idea was the advice that NARSTO needs to bring in new thinkers to enhance the existing community and to gain the support of the institutions – both public and private – from which individual contributors and supporters come.

Some respondents suggested that NARSTO’s activities could be improved if the organization were to take on more quick-turnaround projects, shorter assessments, and focused workshops. Other respondents suggested that NARSTO would receive more support if it were to change its mandate so that it could provide policy advice to senior managers and policy makers – while others indicated that NARSTO would lose support by moving toward policy and away from science.

Finally, respondents advised that NARSTO would be improved were it to change its workplanning processes in such a way that key clientele – and financial supporters – would see NARSTO activities and products as critical to achieving their priorities. By building on the characteristics and capabilities that are unique to NARSTO including, for instance, the trinational participation and its scientific credibility, certain respondents suggested that NARSTO could focus better its products and services in areas where no other capacity exists in North America.

SECTION VI. REVIEW PANEL RECOMMENDATIONS

In response to the Executive Assembly’s Charge #4a, the NARSTO Review Panel recommends to the NARSTO Executive Assembly that NARSTO continue to operate. The Review Panel found strong support from the scientific research community across North America for the value of the organization’s products and activities. The NARSTO Review Panel believes that much additional work could be done by NARSTO. In particular, the Review Panel recommends that NARSTO continue its trilateral cooperation and facilitation activities which have supported and promoted better air quality management decisions across North America. However, for NARSTO to continue to operate, several important changes are recommended in its operations and its relationships to the three governments whose scientific representatives originally signed the NARSTO Charter.

1. FORMALIZE INSTITUTIONAL SUPPORT FOR NARSTO AMONG MAJOR PARTICIPATING ORGANIZATIONS

NARSTO should seek to institutionalize the support of its members in Canada, the United States, and Mexico. In the past, participants in NARSTO have provided support on an individual not an institutional basis. It is important for NARSTO's continued existence that, as individuals move on, support for and understanding of NARSTO's capacities does not disappear. Members of the Executive Assembly should seek to maintain and enhance support from their organizations.

2. INCREASE PARTICIPATION BY POLICY-MAKERS TO HELP IDENTIFY KEY SCIENCE/POLICY QUESTIONS

NARSTO should seek to engage policy-makers within federal and provincial/state governments as well as in industry in all three countries. To assist in obtaining the support of policy-makers, NARSTO should undertake to communicate its achievements to the governments and industries that are most able to make best use of NARSTO's unique characteristics. The full potential of NARSTO cannot be realized without the participation of policy makers. At the same time, it will be important to avoid increasing the size of the NARSTO bureaucracy.

3. STRENGTHEN NARSTO'S STRATEGIC WORKPLANNING PROCESSES

NARSTO should develop a strategic workplanning process that will engage science and policy officials from all three countries. Strategic workplanning would bring together, on an annual or biannual basis, key policy and research personnel from Mexico's SEMARNAT and INE, the U.S. EPA, NOAA, NASA, DOI, DOA, DOT and DOE and Environment Canada along with key personnel in state/provincial governments and industries in all three countries. Such a planning process will be defined by those attributes that are unique to NARSTO while responding to the issues that are highest priority among the governments and industries that participate in and support NARSTO. The benefits would include establishing for NARSTO a workable plan that incorporates goals that are relevant to NARSTO members, timelines that will support member agendas, results to be achieved, activities through which to achieve these results, a review schedule and targets along with financial and in-kind support to be provided. Such a process would strengthen NARSTO's ties to the North American research and policy agendas as they are identified by members representing governments and industry in the three countries.

During the course of the Review Panel's interviews and deliberations, a number of research areas were identified that could provide the initial basis for discussion among governments and the private sector in establishing the upcoming agenda for NARSTO. The Review Panel endorses and recommends these research areas to the Executive Assembly for use as the preliminary basis for discussion in a strategic workplanning process. (See Figure 1 and Appendix IV-h.) While the Review Panel notes that there is substantial interest and enthusiasm in taking on new issues relating to the interface between climate change and air quality, it is the Review Panel's view that NARSTO should return periodically to focus on the topics related directly to tropospheric ozone and particulate matter. These issues remain important and scientifically challenging air quality management problems across North America.

4. ASSURE STABLE AND EQUITABLY DISTRIBUTED NARSTO FUNDING FOR CORE ACTIVITIES

Stable financial support of NARSTO's core activities is a concern that was expressed by a majority of interviewees and those surveyed and a problem that threatens NARSTO's future. Since core funding is essential to NARSTO's continued operation, the Review Panel has certain recommendations that relate specifically to this aspect of NARSTO's funding.

- The Review Panel recommends that the Executive Assembly should decide whether the Quality Systems Science Center should continue to be included as a core activity.
- The Review Panel also recommends that funds to support quick turnaround projects be considered a routine part of core funding.
- The Review Panel recommends addressing NARSTO's funding problem by achieving a more equitable distribution of the funding of NARSTO core activities among key federal agencies in all three NARSTO countries. The Review Panel recognizes that such a model will require some creative thinking about how these activities could be split into distinct work packages that could be funded under various agency procedures and budgetary constraints. This allocation of support could be part of an improved strategic workplanning process, as described above. Besides achieving more equity in funding responsibilities, this model would give Canada and Mexico a stronger voice in setting NARSTO's agenda. Because it involves more than in-kind support, it should result in a more formal multi-agency and international commitment to NARSTO's strategic workplan and activities.

5. REVIEW AND ASSESS NARSTO'S ORGANIZATIONAL STRUCTURE AND PARTNERSHIPS

Other operational or organizational models were suggested for NARSTO consideration during this review, including developing partnerships or collaborative structures that would facilitate its activities in the air quality/climate interface so as to strengthen its unique approach to North American transboundary air quality management and science policy issues. Other suggestions for organizational changes are made such as those in Appendix I-b and NARSTO should consider them. While the Review Panel agrees that such approaches could be considered, the Panel recommends that the current organizational structure with its small management team should be maintained, as it is flexible and responsive to scientific issues as they arise.

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APPENDICES

Appendices to this document can be found at <http://www.narsto.org/reports.src>.

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