Business Plan of the Mercury Air Transport and Fate Research Partnership Area -UNEP F&T-

(NOTE: This is the business plan version of January 2016 with editorial revisions and updates)

This Business Plan describes the activities of the United Nations Environment Programme (UNEP) Global Partnership for Mercury Air Transport and Fate Research (F&T) during the period 2014-2016 and serves as a communication vehicle both for Members, other Partnerships and others. It updates the F&T business plan, developed in an initial version at Gatineau, Quebec meeting (in January 2007) and later posted on the Partnership web site.

The purpose of the business plan is to provide a framework for developing and implementing projects. The business plan is to serve as a resource for providing a common, cohesive structure for implementing the UNEP Global Mercury Partnership.

The partnership is open for government and stakeholder participation. In UNEP Governing Council Decision 24/3 part IV paragraph 27, UNEP is tasked with working in consultation with Governments and stakeholders to strengthen partnerships under the UNEP Global Mercury Partnership as part of the global effort to deal with mercury.

Governing Council 25/5 specified the UNEP Global Mercury Partnership as one of the main mechanisms for the delivery of immediate actions on mercury during the negotiation of the global mercury convention.

New partners and proposals for new projects and activities are encouraged within the UNEP Global Mercury Partnership.

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I. Summary of the Issues

An improved understanding of mercury emission sources, fate and transport is important in:

(a) setting priorities at the national, regional and global levels,
(b) developing and implementing policies and strategies,
(c) establishing baselines to monitor and assess progress on mercury reductions,
(d) developing models to document spatial gradients and identify biological mercury hotspots
(e) identifying science-based metrics (for compliance) and bioindicators (for monitoring)

Integrated global assessments, based on valid data and information from regional and national levels, are essential for global understanding and for predicting trends. However, there is a lack of global monitoring coverage and coordination in research efforts.

With competing resources and priorities at the national, regional and global levels, cooperation and coordination among the partners, countries and stakeholders in the field of atmospheric and ecosystem mercury research and monitoring, aiming to achieve the objectives below would help bring about a greater understanding of mercury uses and releases, and achievement of cost-effective reductions in mercury contamination.

II. Objectives of the Partnership

F&T aims to increase global understanding of international mercury emissions sources, fate and transport by:

- Accelerating the development of sound scientific information to address uncertainties and data gaps in global mercury cycling and its patterns (e.g., air concentrations and deposition rates, source-receptor relationships, hemispheric-global air transport/transformation emission sources, transboundary movement through hydrological and atmospheric pathways, air/water exchange, aquatic mercury cycle and exposure in biota, particularly fish);
- Enhancing the development of scientific information on aquatic transport and fate of methylmercury to biota as well as human exposure, recently included amongst the objectives of the Partnership's research activities
- Enhancing compilation and sharing of such information among scientists, between scientists and policymakers and with various global stakeholders and other interested parties;
- Providing technical assistance and training, where possible, to support the development of critical information;
- Enhancing the development of a globally-coordinated mercury observation system to monitor the concentrations of mercury species and POPs in cooperation with the Group on Earth Observations (GEO) according to GEO 2016 Work Programme, the first of the new GEO decade 2016-2025. (GEO Initiative GI-04 titled 'Global Observing System for Mercury and Persistent Organic Pollutants (PoPs))
- Enhancing the exchange of information and cooperation with the Task Force on Hemispheric Transport of Air Pollutants (TF HTAP) of the UNECE-LRTAP Convention as well as with relevant International Organizations and Programmes.
- Monitoring, assessing, and reporting information that can be used as the basis for assessing the environmental and public health benefits and effectiveness of global mercury reductions pursuant to the Minamata Convention on Mercury and other relevant mercury reductions strategies

The F&T will continue to act as an integrator of scientific information among the partnerships and will also continue to support the overarching goals of the UNEP Mercury Programme, including contributing to, coordination and liaison with various organizations and programs. Such programs include the United Nations Economic Commission for Europe, Arctic Monitoring and Assessment Programme, UNEP Regional Seas, Task Force on Hemispheric Transport on Air Pollutants of the UNECE-LRTAP convention, and the International Union for Conservation of Nature (IUCN). The F&T will also give its scientific support to the UNEP Mercury Programme as well as to national and international organizations for the promotion, ratification and implementation of the Minamata Convention on Mercury.

III. Long-Term Priority Actions

The following table identifies long term priority actions and then links them with various current partnership efforts (further described in Paragraph IV) and timelines.

Long-Term Priority Actions	Current Partnership Efforts and Timelines	Future Strategic Initiatives to be considered to fill the gaps
• Coordination in conducting research projects related to partnership objectives and scope on national/regional/global scales on ***cross-cutting issues of the mercury cycle***.	• The leader of the F&T in cooperation with partners and other research and university institutions in the world has coordinated a 5-yr project "Global Mercury Observation System (GMOS)", funded by the European Union's Seventh Programme for research, technological development and demonstration, which is aimed to build a global observing system of mercury contamination. GMOS started in November 2010 and has been concluded in 2015. GMOS has established a strong cooperation with on-going regional programs in US, Canada, Japan and China as well as with international programs i.e., UNEP, UNECE-TF HTAP, GEO/GEOSS. The GMOS recent results are described in Appendix A.	• GMOS will support major international programs and conventions aiming to evaluate the effectiveness of control measures that will be adopted in the future to reduce the impact of mercury pollution related to anthropogenic activities on human health and ecosystems (more details at: www.gmos.eu). Specifically GMOS has contributed to the preparation of the UNEP report (see above) for consideration by Governing Council/Global Ministerial Environment Forum at its twenty-seventh session" in 2013. The F&T will be involved in the next deliver of the Global Mercury Assessment 2018 (see Appendix B).
• Develop ***global, coordinated network of measurements*** for ***assessing levels*** of mercury and its species in the atmosphere and water – improving the comparability among measurements and observations	• Conduct atmospheric monitoring and make summary data available (Canada, South Africa, United States) • Share sampling and monitoring methodologies and provide training on the operation and maintenance of mercury speciation instrumentation and mercury wet deposition sampling equipment (U.S. and Canada). • Measure mercury in precipitation and make summary data available (Canada, South Africa, United States) • Expand mercury measurements to include speciation (RGM, Hg(p)) (Canada, South Africa, United States) • Develop common protocols for the measurement and estimation of Hg dry deposition (Canada and United States), • USEPA will share speciated measurements of mercury together with other pollutants, taken during 2002-2009, at the U.S. National Oceanic and Atmospheric Administration's high altitude station at Mauna Loa, Hawaii. • More recent USEPA-funded speciated mercury measurement data (2010 to present) from Mauna Loa are available through the National Atmospheric Deposition Program (NADP) and NOAA Air Resources Laboratory.	• Encourage joint initiatives to promote training on mercury measurements in ambient air and flue gases. (Italy, Slovenia). • Support international programs and initiatives (IGBP-IGAC, UNEP, AMAP). (Italy) aiming to understand the dynamic of pollutants such as Hg between ecosystems and to elaborate policy options. • Continue to support UNECE-LRTAP convention for shaping future international mechanisms aimed to reduce the mercury emissions to the atmosphere and its impact on ecosystems and human health (Italy, U.S.).
• Develop ***global, coordinated network for research on source-receptor relationships*** effort that would allow for the creation of modeling framework for	• Research projects on mercury transport, cycling and deposition of mercury to the Polar environment and across Canada (Canada). • Development of methodologies for the identification of mercury sensitive areas in the marine environment (Slovenia) •	• To support the GESAMP initiative on mercury in the marine environment in the framework of initiatives carried out in F&T. • Coordinate and develop a database which will generate spatial layers depicting existence of Hg data in

understanding global fate of mercury		biota – particularly coastal and open ocean fish - by region and identify biological mercury hotspots for future linkage with atmospheric cycling data and data on watershed sources of mercury.
• Develop a global, commonly accepted ***modeling framework for source-receptor relationships*** assessment at global and regional scales	• Canada has developed the global/regional atmospheric heavy metals model (GRAHM) for the distribution of atmospheric mercury • GRAHM used to estimate intercontinental transport of mercury to various regions (Canada) • South Africa is developing a MERIECO model (Bayesian Network) to determine the linkages between Hg from source to receptor. • Share worldwide meteorological data through the READY web-based system (U.S.). • Share various transport and air dispersion models (U.S.) • BRI (US) is developing a global biotic Hg database with an emphasis on marine organisms that can be used to identify biological Hg hotspots that may be of particular concern for human and ecological health. • USEPA will share a multi-media modeling methodology now being developed by Harvard University under contract to EPA, that relates global emission inventories to changes in methylmercury fish concentrations in various marine regions of the world, and, thus, provides a framework for estimating individual country exposures associated with those sectors	• Coordinate with the UNEP Live platform that can serve as a partner clearinghouse of Hg related information.
• Develop ***global emissions and releases inventories***, e.g., by filling current gaps in geographic and source coverage which includes information on regions not yet accounted for and on sources not yet accounted for in currently used databases, e.g. biomass burning, artisanal gold mining, coal-bed fires and natural sources. F&T will give particular emphasis to the development of global emission inventories that will consider separately source by source in all industrial sectors	• Maintain and make available national mercury emissions information (Canada, United States) (ongoing; annual reports) • Develop and implement a program to quantify bi-directional mercury flux from oceans, lakes, soils and vegetation (Canada, U.S.). • South Africa is currently completing a Hg inventory for the country. • South Africa and Norway are working together on developing Hg scenarios for the country. • Share worldwide coal inventory (http://energy.er.usgs.gov/coalquality/wocq/collaborators.html) (U.S.).	• Combine emissions and watershed releases data to provide a global map of all mercury sources
• ***Build capacity***, including through the provision of ***training programs***, related to partnership objectives and scope monitoring, modeling and other tools in countries	• South Africa held a Hg analytical training programme in conjunction with international Hg experts • Training in mercury analysis and speciation in environmental matrices (Slovenia) • Training in analytical methodology, analysis, QA & QC (DLCS Scotland)	• Establish a global paired sampling program with local NGOs to link and understand fish with associated human hair Hg concentrations

where necessary	• BRI (US) is organizing multiple training sessions for biologists from Central and South American countries to measure Hg levels in biota (aquatic and terrestrial biota). • Providing multiple training and demonstration workshops for agency scientists in the Asia-Pacific region on mercury wet deposition sampling operations and methods for gaseous and particulate atmospheric mercury sampling (USA).	
• Build on existing international activities work already underway internationally, e.g., GEOSS, Arctic Council, UNECE-HTAP, WMO, AMAP	• Canada participated in two model intercomparison studies (led by EMEP and EPA) and contributed to UNECE-HTAP interim and final assessment reports on the evidence for intercontinental transport. • Through the CEC Canada and US are assisting Mexico to seek funding to continue and expand programs for mercury monitoring.Through the AMNet network, the US and Canada collaboratively make atmospheric speciation measurements.	• Italy with WHO will take part and contribute to the UNEP/GEF Global project on the '*Development of a Plan for Global Monitoring of Human Exposure to and Environmental Concentrations of Mercury'* lead by UNEP aiming at harmonizing approaches for monitoring mercury in humans and the environment, and at strengthening the capacity for mercury analysis in humans and the environment to accurately determine their concentrations globally.
• ***Assessment and fate of mercury in marine, freshwater, and terrestrial ecosystem***s from various sources including atmospheric	• C-MERC convened a team of scientists and stakeholders to work together over a two-year period to gather and analyze data. 11 peer-reviewed papers were published papers which will elucidate key processes related to the inputs, cycling and uptake of mercury in marine ecosystems and human exposure and health effects. The synthesis report, "Sources to Seafood was published in December 2012. http://www.dartmouth.edu/~toxmetal/C-MERC/index.html • BRI (US) coordinates with several academic, governmental institutions and UNEP around the world to maintain the Global Biotic Mercury Synthesis (GBMS) database. • BRI, USEPA and the National Atmospheric Deposition Program and collaborators (US) continue to develop and expand MercNet – a comprehensive and integrated National Multi-media Mercury Monitoring Network. This template is proposed to be used globally to develop a Technical Information Document to provide guidance to the COP about how, where, what and why to monitor mercury. • GESAMP through the DLCS will produce a synthesis of known literature to date including compilation of known models and EQS values used worldwide • Development of protocols for mercury analysis and speciation in water (Slovenia) • Developing metrology support in mercury analysis and contribute to worldwide comparability of the results (Slovenia) • Develop global protocols for monitoring water, sediment & biota. • Canada is scientifically contributing to advancement through several research	• Canada is completing the Canadian Mercury Science Assessment Report that has coordinated all Canadian Activities that could be used as a benchmark for other countries to follow. • Build on the European Metrology Research Fund (EMRP) to develop primary mercury standards for calibration of instruments and therefore establish metrologically valid traceability chain. • Build a global database for marine ecosystem biota, both coastal and open ocean, to establish a baseline from which effectiveness evaluation of mercury controls can be done. Identify common trophic groups and species that could be useful for determining spatial and temporal variability of mercury bioaccumulation.

	programs including the Clean Air Regulatory Agenda Mercury Science Program, the METAALICUS project, ArcticNet, Northern Contaminants Program and the JOSM program.	
• Contribution of ***contaminated sites*** to the global mercury cycle	• An assessment of the contribution of contaminated sites to the global mercury budget (Slovenia) • Position papers for characterization and identification of contaminated sites; modelling approaches, remediation and health surveillance will be compiled (Slovenia, Japan)	

IV. Current Partnership Efforts and Timelines

Each country and organization's contribution are provided in Appendix C of this document. The following is a summary of contributions.

- In the framework of GMOS activities Harmonized Standard Operating Procedures (SOPs) for atmospheric and oceanic measurements have been prepared and made available to a broader community of scientists and policy makers.
- A revision of atmospheric emissions from major anthropogenic and natural sources has been recently published within GMOS in cooperation with other GMOS partners including NILU (WP Leader on emissions within GMOS) and partners of F&T.
- Maps of spatial and temporal distribution patterns of mercury species have been prepared with state-of-the-art atmospheric mercury modeling systems.
- Expansion of F&T scope to include oceanic transport, methylation, bioaccumulation and exposure, as decided in its 11/25/09 teleconference. This expanded role of the partnership to integrate the science linking global emissions and exposure will benefit UNEP and the individual partners;
- Relevant outcomes have been made available on the F&T and GMOS (www.gmos.eu) web portal for scientists, policy makers and stakeholders.

During the period January 2014 - July 2016 the Partnership team members have met many times.

In **2014** the F&T has taken part to the following meetings, workshops and committees:

- From 25th to 28th February 2014 has participated to the Workshop on Pollution of Open Ocean which was held at International Atomic Energy Agency (IAEA) Environment Laboratories in Monaco under the aegis of the Joint Group of Experts on the Scientific Aspects of Marine Protection (GESAMP);
- In April 2014 (14-15th April), The GMOS Mercury Modelling Task Force has taken place at the CNR-IIA, in Rome. The meeting was attended by colleagues from the US, Canada, Russia and Germany, with a number of colleagues worldwide connected via videoconferencing;
- In July 2014, from 9th to 10th F&T has organized a workshop in Rome on the GMOS Data Quality Management System (G-DQM) in the framework of the global GMOS network;
- On July 28-30, F&T has taken part to the 3rd International Conference on Earth Science & Climate Change, San Francisco, USA, 2014.
- In October 2014 F&T will take part to the sixth PAG - Partnership Advisory Group meeting to be held between the 30th of October and the 1st of November 2014 in Bangkok, Thailand, back to back with INC6, which will be held from November 3-7, 2014.

In **2015**, the F&T has taken part to the following meetings, workshops and committees:

- In June 2015, F&T had a leading role at the ICMGP Jeju, South Korea meetings contributing, inter alia, to the organization of the UNEP Special Session with presentation on 'Fate & Transport Partnership Area UNEP Global Mercury Partnership The UNEP F&T contribution to the Minamata Convention process: possible synergies between science and policy' held on 15th June;
- On 16th June, F&T has taken part to the Partnership Area Leads Meeting organized by UNEP Global Mercury Partnership, in Jeju, South Korea;
- In October, from 20 to 22, F&T has taken part to the 11th SETAC (Society of Environmental Toxicology & Chemistry) Europe Special Science Symposium (SESSS), and the 'Mercury Platform Workshop' organized by SETAC.

During the period 2014-2016, the Partnership has had several teleconferences and many contacts with other F&T partners in order to assure an efficient exchange of information and, in the same period, has taken part in many meetings and workshops.

V. Future Strategic Initiatives to be Considered to Fill the Gaps

Areas identified within the F&T Partnership for further investigation include:

- Harmonization of mercury emission and releases inventories;
- Development of a global observing system to monitor and model mercury contamination at regional and global scale. This could be done using GMOS as a framework, considering that GMOS is currently the only international initiative aiming to build a global observing system for mercury, to support the implementation of future legally binding instrument aiming to reduce the impact of mercury emissions on human health and ecosystems that are under preparation (INC process) in the framework of the UNEP Mercury Program and last GC meeting's decisions.
- Close coordination with the Group on Earth Observations (GEO), the organization working to built GEOSS (the Global Earth Observation System of Systems), to include mercury in GEOSS work plans;
- Further involvement of the F&T partners in several International Conferences.
- Further coordination and liaison with various organizations and programs (such as United Nations Economic Commission for Europe, Arctic Monitoring and Assessment Programme, UNEP Regional Seas Program);
- Further development of a global biotic Hg database that will provide a baseline of mercury levels from which to evaluate Mercury Treaty effectiveness. Place particularly emphasis on marine coastal and open ocean fish and other food items which are important to monitor for human health purposes. Link Hg data with harvest data from the FAO;
- To explore opportunities to integrate current or proposed Hg monitoring programs for biota in the western hemisphere that can be used for global monitoring purposes and linked with measurements of air deposition and watershed releases;
- To expand the scope of F&T to include dispersed sources of mercury to the global mercury budget, such as re-emission of mercury from contaminated sites (including emissions to the atmosphere and water cycle);
- To expand the scope of F&T by including ecosystems that are sensitive to the mercury load (i.e.; biological mercury hotspots). Indicators and metrics still to be developed;
- To liaise with supporting activities already provided through regional meteorological institutions. This link will enhance and strengthen the quality of measurement results and secure worldwide comparability (stronger collaboration with the WMO is suggested) and may assure a sustainability of efforts and coordination globally;
- To develop global protocols for monitoring of waters, sediments & biota in terrestrial, freshwater, and marine ecosystems that will assist in model development
- To join new European Projects, such as the Research Project "ENV51 Metra: Traceability for mercury measurements" (SRT-v11) to support the requirements of national and international legislation (e.g. the

UNEP Minamata Convention on Mercury), which aims at controlling mercury emissions and releases, selected and approved by the European Metrology Research Programme (EMRP) Call 2013 – Energy and Environment. The EMRP is funded by the EMRP participating countries within EURAMET and the European Union. The project coordinated by the JRP-Laboratoire national de métrologie et d'essais (LNE), France will start on the 1st of October 2014 and be of 3 years duration.

- To join new Global Projects, such as the UNEP/GEF Global project on the '*Development of a Plan for Global Monitoring of Human Exposure to and Environmental Concentrations of Mercury',* led by UNEP DTIE Chemicals Branch, aiming at harmonizing approaches for monitoring mercury in humans and the environment, and at strengthening the capacity for mercury analysis in humans and the environment to accurately determine their concentrations globally. The project, approved and funded by the GEF will be of a 2 year duration.
- Hold F&T partnership meeting(s) and/or teleconferences subsequent to next INC-7, as appropriate, to discuss path forward on how F&T partnership can assist with implementation of the Minamata Convention requirements.

VI. Evaluation

The partnership areas will report biennially to UNEP in accordance with the UNEP reporting format[1]. Reporting will include monitoring performance (tracking partnership activities and partner contributions) as well as assessing effectiveness (measuring the impact of partnership activities on target beneficiaries).

Partners will also provide periodic reports to UNEP upon completion of priority activities.

VII. Resource Mobilization

Partnerships and the associated business plans are a way of mobilizing funding in a systematic, focused and harmonized way. The Partnerships' objectives and business plans should provide clarity for potential donors and finance institutions. The business plans should encourage and facilitate donors to support activities and provide a tool to leverage funds.

Funding for Partnership Activities:

Partners can develop specific initiatives, work with non-partners, or pursue projects consistent with partnership objectives.

It is hoped that the Partnership will serve as a mechanism to consolidate and leverage funding for large, strategic projects. If partners wish to leverage funding for particular projects, details should be outlined within this section.

Partners are encouraged to contribute not only financially but also to offer in-kind assistance. Developing countries and countries with economies in transition can also submit requests for funding to UNEP under the UNEP Mercury Small Grants Programme. UNEP could consult with the partnership area for expert advice when such proposals are developed.

The partnership area has proposed possible ways to engage international donor agencies and make them aware of Partnership activities and needs, such as:

- informing other countries of opportunities to pursue possible financial support from different agencies, such as the Asian Development Bank, World Bank, other regional funding institutions, and that it is desirable that these agencies be involved in the beginning of the process, and

- considering ways to market the significance of mercury studies to major funding organizations so that the study of mercury pollution is included in their selection criteria as an issue with significant socio-economic implications, such as linking the change of mercury methylation and availability with changes in climate patterns.

VIII. Business planning process

The business plan will be reviewed regularly and adjusted accordingly by the partners. Ideas are welcome on how best to take stock of efforts, determine whether the direction of the Partnership for the various projects need to be re-considered, and measure the productivity of the efforts under the Partnership.

IX. Linkages with other Partnerships and with other entities

The F&T Partnership serves to integrate and enhance the work of the other Partnerships and other programs by providing information within the scope of its objectives.
Possible linkages with other air-emission-related and marine partnership areas and further planning on various joint projects will be explored and improved in the next years.

X. UNEP F&T website

The F&T has established and updated a website at http://www.iia.cnr.it/index.php?option=com_content&view=article&id=479&Itemid=40&lang=it
, to serve as a bulletin board for sharing information within the Partnership and provide up to date information to policy makers and stakeholders. The UNEP website on which information is available on all Partnerships is: http://www.unep.org/hazardoussubstances/ Mercury/tabid/434/Default.aspx.

XI. Partners

Please see Appendix D of this document for the current list of partners (under revision, at this stage, for future possible integrations of new partners) that have submitted letters of support to the UNEP Global Mercury Partnership. There are a number of participating partners that have not officially submitted support letters.

Other partners are welcome to join the partnership at anytime.

Appendix A - Results of the Global Mercury Observation System Project (GMOS- www.gmos.eu)

The Global Mercury Observation System (GMOS) is a five year project (2010-2015) that has involved more than twenty institutions from Europe, North and South America, Asia and Africa take part in the project. This project, lead by the Italian National Research Council - Institute of Atmospheric Pollution Research (CNR-IIA), has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No. 265113.

The primary goal of the Global Mercury Observation System project (www.gmos.eu) was the establishment of a worldwide observation system by integrating ground-based monitoring sites, ad-hoc oceanographic cruise campaigns and lower stratospheric and tropospheric studies, which can provide concentration data for mercury and its compounds in air and precipitation, as well as in marine ecosystems.

During the planning and implementation stage of GMOS, particular attention was paid to set the protocols governing measurement and sampling techniques and harmonization. This is fundamental to being able to provide high quality data and ensure that data management complies with international standards of data interoperability and to guarantee full comparability of site specific observational datasets.

At the hub of the GMOS project has been the Spatial Data Infrastructure (SDI). The SDI performs multiple roles, it is directly connected to ground based monitoring sites to collect (and store) real time mercury measurement data, it also gathers information on measurement instrument performance to enhance the data QA/QC, and is
configured to provide alerts and reminders to site operators in cases of both urgent and routine instrument maintenance. The SDI also serves as a repository for mercury emission databases, historical mercury measurement data, and also stores modelling output from the regional and global modelling initiatives within the GMOS project.

Major GMOS results include:

- Establishment of the global monitoring system for mercury with 28 land based monitoring sites (see GMOS website – www.gmos.eu);
- Completion of oceanographic and aircraft measurement campaigns;
- Planning and implementation of a centralized repository archive and established advanced web services;
- Establishment of a database of historical, current and future scenario mercury emissions.
- Continuing collection of atmospheric mercury species concentrations;
- Continuing collection of precipitation samples for mercury analyses;
- Improvement, validation and intercomparison of regional and global scale atmospheric mercury models (the latter with external partners within the GMOS Mercury Modelling Task Force (MMTF);
- Model application to evaluate source-receptor relationships, temporal trends and future emission scenarios;
- Preparation of a white paper, still in progress, aiming to provide a framework for using GMOS as a model for global monitoring of mercury under Minamata Convention on mercury, that will be supplied to all partners by the end of 2014.

GMOS has cooperated closely with major international programs including the UNEP Global Mercury Partnership, the Task Force on Hemispheric Transport of Air Pollutants (TF HTAP) of the LRTAP Convention, the GEO Task HE-02-C1 "Tracking Pollutants" and the Arctic Monitoring and Assessment Programme (AMAP).
GMOS also supports the Italian National Reference Centre for Mercury (CNRM- www.cnrmerc.org)

Appendix B - Global Mercury Assessment 2018

UNEP's Governing Council has charged UNEP with updating its 2013 Global Mercury Assessment (GMA) within a period of 6 years, i.e. for delivery no later than 2019. Preparatory work has been initiated by UNEP , including the identification of necessary resources and the development of the plans elaborated in this prospectus.

Focus of Work

Key aspects of the intended work are:

- To update the (Technical Background Report for the) 2013 GMA, building on previous work and tools developed to accomplish that work.
- Main focus will be on updating global emissions and releases inventory components (for the target year of 2015), especially for sectors of relevance for the Minamata Convention.
- The assessment will be expanded with respect to quantification of releases and discharges of mercury to the aquatic environment, and include an overview of mercury levels in biota.
- Developed inventory estimates will be compared with nationally reported emissions and releases estimates, including those being developed through ongoing UNEP/UNITAR/UNIDO/UNDP-coordinated national inventory work such as the GEF-financed Minamata Initial Assessments (MIAs). This work will facilitate a dialog regarding future improvement of emission and release estimates.
- Additional sections of the GMA 2018 will address mercury environmental fate and transport.
- A GMA 2018 report suitable for a 'policy' target audience will be produced by end-2018 for delivery in 2019. This report will summarise a comprehensive technical background document to be produced between 2016 and 2018.

Teams of experts leading work on five components are going to be organized (Emissions Team, Release Team, Modelling Team, Aquatic Environment Team, Environmental Observations Team). These teams will develop detailed plans for the conduct of work that will result in timely provision of the required products and deliverables.

It is expected that the UNEP Mercury Partnership Areas will contribute significantly to the work.

Appendix C - Contributions from Partners

C1 - Contribution from Italy

Italy is leading the UNEP F&T in cooperation with Canada, Japan, Slovenia, South Africa, China, USA and UNEP. The work plan of the Partnership along with a description of the progress made, the specific contributions of the partners and products of the Partnership are reported in detail on the Partnership's web site. Italy will continue to maintain and update the web site.

The Italian contribution to the Partnership is related to different aspects of atmospheric mercury emissions, transport and transformations on regional and global scales. Activities are carried out in the Mediterranean region, in China and in Polar regions as well as in leading GMOS. The specific projects and programs leaded by Italy in 2009-2011 and planned for the following two years are briefly reported below.

GMOS: Global Mercury Observation System, funded by EC as part of EC FP7 – Italy leads GMOS which has involved 24 partners from all over the world and has cooperated with on-going programs in USA, Canada, China, Japan. GMOS was aimed to merge ground-based networks, oceanographic programs and tropospheric programs. More is available at www.gmos.eu.

UNECE-HTAP Task Force, WG on Hg: Italy is Leading the Working Group on Mercury. The major goals of this WG was to perform a modeling intercomparison for assessing the effectiveness of emission reduction measures and an assessment of the relative contribution of natural vs. anthropogenic sources on hemispheric and global scales. Results have been published in the TF HTAP Report, Part B: Mercury, published in 2010 and submitted to the Steering Body of EMEP/UNECE-LRTAP (http://www.htap.org)

Polar research program: As part of the Italian Polar Research Programme (PNRA) Italy is performing (2012-2014) an intensive campaigns in Ny-Alesund on the Svalbard Islands at the Italian research site and at DOME-C in Antarctica (Italian-French bi-lateral program). The aim of this project is to investigate on mercury depletion mechanisms that affect the transfer of mercury from the atmosphere to surface snow in both polar areas.

Research Project "ENV51 Metra: Traceability for mercury measurements" (SRT-v11): Italy will support, trough this project, the requirements of national and international legislation (e.g. the UNEP Minamata Convention on Mercury), which aims at controlling mercury emissions and releases. This project, which will establish the required metrological infrastructure for mercury measurements in all environmental media, needed by current and future national and international legislation aimed at controlling mercury emissions and releases, was selected and approved by the European Metrology Research Programme (EMRP) Call 2013 – Energy and Environment. The EMRP is funded by the EMRP participating countries within EURAMET and the European Union. The project coordinated by the JRP-Laboratoire national de métrologie et d'essais (LNE), France will start on the 1st of October 2014 and be of 3 years duration.

UNEP/GEF Global project on the 'Development of a Plan for Global Monitoring of Human Exposure to and Environmental Concentrations of Mercury': Italy will contribute, with WHO, to the project aiming at harmonizing approaches for monitoring mercury in humans and the environment, and at strengthening the capacity for mercury analysis in humans and the environment to accurately determine their concentrations globally. The project, approved and funded by the GEF, will be lead by the UNEP DTIE Chemicals Branch and will be of a 2 year duration.

C2 - Contribution from Canada

Canada maintains a domestic mercury emission database under the National Pollutant Release Inventory (NPRI) program.

Canada has been measuring total gaseous mercury (TGM) and atmospheric mercury speciation since 1997 and 2001, respectively, across the country. Trend analyses on both the TGM and speciation data have been published and will be included in the Canadian Mercury Science Assessment. The data are publicly available in Environment Canada's NAtChem database and can be made available to the global scientific community. Standard operating procedures and quality control protocols and a full software system have been developed by Canada for atmospheric mercury measurements. These protocols and system are used throughout the monitoring sites in Canada and can be made available. Canada continues to provide guidance and assistance on training and building capacity on atmospheric mercury measurement processes both domestically and internationally.
The level of mercury in precipitation is determined at sites across Canada as part of the Mercury Deposition Network (MDN). The data are publicly available on the MDN website. Canada maintains two "external" sites within the US AMNet dry deposition network. Canada conducts significant mercury processes research aimed at understanding environmental pathways by which mercury is cycled in the environment.

Canada works internationally through agreements such as the NAFTA CEC North American Regional Action Plan (NARAP) on mercury, New England Governors/Eastern Canadian Premiers (NEG/ECP) action plan on mercury, Great Lakes Binational Toxics Strategy and the Arctic Council Action Plan on Mercury and contributes to the Arctic Monitoring and Assessment Program and the United Nations Environment Program.

Canada is compiling its first national picture on mercury research entitled the Canadian Mercury Science Assessment to be produced 2014-2015. The Assessment will be the first comprehensive national description of mercury in the Canadian environment. The assessment is intended to inform decision-making by policy-makers and research managers and establish a baseline against which future changes in mercury levels in the environment can be attributed to changes in mercury emissions and climate. This assessment highlights the continuing significant contribution that Canada makes to scientific research and monitoring of mercury both nationally and internationally.

Canada authored the Canadian Arctic Contaminants Assessment Report III in 2013. This report summarizes all the research and monitoring that Canada has undertaken in the Arctic. This is the 3rd report on the Canadian Arctic contaminants research and the first to exclusively report on mercury Canada continues to investigate the transport, cycling and deposition of mercury to the polar environment. Canada has the longest record of atmospheric mercury measurements in the Arctic. The Northern Contaminant Program, as part of Aboriginal Affairs and Northern Development Canada, has been monitoring mercury in both biotic and abiotic media across Canadas north for over 20 years. Canada significantly contributes to AMAPs database through this program.

Canada has developed the global/regional atmospheric heavy metals model (GRAHM) for the distribution of atmospheric mercury. This model provides source-receptor relationships to estimate the intercontinental transport of mercury to various regions. Canada has integrated a suite of computer models for atmospheric, terrestrial, aquatic, and bioaccumulation processes into a single framework and used it to simulate the effect of different emission reduction scenarios on fish mercury levels in Canadian lakes.

Through the Commission for Environmental Co-operation, Canada provided instrumentation and training to measure GEM concentrations at various sites in Mexico, aided the implementation of 2 MDN sites in Mexico and is assisting Mexico to seek funding to continue and expand these programs (with USA).

Canada continues to contribute to the International Conference on Mercury as a Global Pollutant conference series through the Scientific Steering Committee and serving directly as a guide to the chairs of each conference through the conference procedures and processes to ensure that the high quality of this series is maintained.

Canada is a partner in the Western Mercury Synthesis report. This report will be a collection of peer reviewed papers synthesizing all the mercury research that occurs in western Canada, USA and Mexico. It is anticipated

that this product will be available as a special issue in a journal by 2015 or 2016. Canada was a partner in the Coastal and Marine Mercury Ecosystem Research Collaborative (CMERC).

Cohesive mercury monitoring in air, deposition, snow, water and wildlife continues as part of the Joint Oil Sands Monitoring program for Canadas oilsands region. This plan was developed by the Canadian Minister of the Environment in collaboration with the province of Alberta.

Canada is an external partner and a member of the scientific advisory board for the Global Mercury Observation System (GMOS) that is being developed to monitor the effectiveness of implementation of regulations for the global reduction of mercury emissions.

C3 - Contribution from Japan

Monitoring Project for Ambient Atmospheric Mercury and Other Heavy Metals in Remote Background Areas – Japan started a monitoring program that will provide background air monitoring data of mercury and other heavy metals to contribute to the understanding of their atmospheric long-range transport. For this purpose, the Ministry of the Environment started a pilot project at the Cape Hedo Atmosphere and Aerosol Monitoring Station in Okinawa, in February 2007. The objectives of the pilot project are to:
Monitor current levels of toxic trace elements, including mercury, in air, particles, and precipitation;
Obtain useful information on the long-range transportation of trace elements in Asia-Pacific region;
Develop monitoring methodologies and measurement items;
Contribute to the international efforts in ambient atmospheric monitoring.

Measurement items, sampling and analysis:

Mercury speciation in atmosphere such as gaseous elemental mercury (Hg(0)), divalent reactive gaseous mercury (RGM), and total particulate mercury (TPM) are continuously measured with Tekran mercury speciation system

- Airborne particles are collected on a polytetrafluoroethylene filter using a low-volume sampler. Toxic trace elements including Pb, Cd, Cu, Zn, As, Cr, V, Ni, ,etc…, in particles are analyzed with the inductively-coupled plasma mass spectrometer (ICP/MS) once a week.

- Precipitation samples are collected using an automatic wet-only sampler, and toxic trace elements are measured once a month. Toxic trace elements and their analytical methods are the same as those of particulates.

Modeling fate of mercury species in multimedia environment:

Long-range transport of mercury species has been simulated by a number of atmospheric transport and chemistry modeling frameworks. Although atmospheric transport and resultant deposition are believed to be the major source of entry into surface environment, inter-media processes between air and surface media including water, soil and others may not necessarily be described in existing modeling frameworks sufficiently. National Institute for Environmental Studies has developed a multimedia-modeling framework to assess the inter-media transport of mercury species through media-boundaries based on the multimedia-modeling framework for organic chemicals, which mainly focuses on the inter-media transport of media boundaries explicitly. By combining existing chemical/transport atmospheric modeling experiences to the inter-media transport simulation, more comprehensive fate modeling including both air and terrestrial/aquatic environment would be possible for more integrated assessment purposes. The objective of the pilot project is to:

- develop inter-media transport scheme and process descriptions for mercury species by expanding the multimedia modeling frameworks from the monitoring outputs.

Methods: Multimedia fate model G-CIEMS is used as the basis of the study, which is now under POP model inter-comparison study by MSC-E/EMEP. Hg(0), RGM (Hg2+), Particulate and MeHg are the first set of target chemicals for the study.

- Results of the existing and current new monitoring information (e.g. Shizuoka site) are to be used to the monitoring and modeling analysis efforts.
- After box-model study of multimedia processes, integration to the atmospheric chemistry and transport scheme will be explored for the final goal of the project.

C4 - Contribution from Slovenia

Slovenia has compiled a report for the contribution of contaminated sites to the global mercury cycle. A workshop was organized in October 2010 to address this issue from a global perspective. Synthesis papers have been prepared and distributed at the negotiating meetings.

In May 2011 Slovenia in collaboration with COST, GMOS and GEOTRACES has organized a workshop on mercury analysis and speciation in seawater. This workshop addressed the issue of comparability of data for mercury analysis and speciation in marine waters, develop common protocols, set the rational for speciation and determination of flux measurements.

In 2011 a new EMRP project started (in collaboration with EU partners) on setting the metrology support for mercury measurements in the environment.

C5 - Contribution from South Africa

A South African Mercury Assessment Programme (SAMA) was established during 2006 to serve as the principal programme through which mercury research in South Africa is co-coordinated. Its are: to co-ordinate and facilitate high-quality research relating to Hg pollution in South Africa; to develop and execute a co-coordinated plan to achieve this, based on partnerships; and to provide opportunities for collaboration and training for young scientists. More information can be obtained at: www.waternet.co.za/sama. To date, partners of the SAMA Programme focused on different aspects of mercury research. As mercury acts differently in different systems, emphasis was placed on all systems (water, air, terrestrial environment, and human health). The projects undertaken by the partners are as follows:

CSIR: A few pilot studies, funded by the CSIR and National Research Foundation, were undertaken. The studies form part of a larger project that focuses on:

- A mercury inventory for South Africa, and developing scenarios on its emissions;
- A national survey of mercury pollution and impacts in South Africa to determine the sources, fate and transport of Hg in South Africa, in air and water resources;
- Mapping information obtained in national survey, using large-scale multidisciplinary mapping;
- Evaluating the impacts of artisanal gold mining on human health and environmental health; and
- Developing and/or identifying appropriate mitigation processes or actions for ameliorating the Hg pollution that has been identified.

A mercury inventory on coal combustion (its sources and emissions to the environment) was established during 2006, and information will be published in the peer reviewed literature during 2008. In order to complete the inventory and to provide updated information to UNEP, this study has been extended during 2007 to include other mercury sources (household appliances, landfill sites, cement factories, waste incinerators, etc).

A pilot study on the fate and transport of mercury in selected South African rivers in the Western Cape (Liesbeek, Black, Eerste/Kuils, Silvermine), and Gauteng and Mpumalanga (Steenskoolspruit, Vaal River) was undertaken. Total mercury and methylmercury analyses were made of all air, water, sediment and biota samples collected, in collaboration with the University of Connecticut, USA. Detailed Hg studies were

undertaken in collaboration with University of Connecticut, USA, and as part of MERSA, Norway, during 2007. A historical analysis of mercury in sediment of selected water resources was undertaken during 2006, and continued during last years.

A pilot study on mercury emissions from artisanal gold mining in South Africa was undertaken during 2007. The study focused on the Limpopo/Mpumalanga Provinces, where artisanal gold mining is believed to take place.

Department of Water Affairs and Forestry: Funded by the Department, total mercury in water resources has been measured since 1975, as part of South Africa's National Monitoring Programme. Monitoring of water resources will continue.

SASOL: Funded internally by SASOL, research has focused on understanding mercury released from coal during the Fischer-Tropsch process; and also focuses on the safe disposal of the elemental mercury that is recovered. Research will continue.

University of Stellenbosch: This group focuses on analytical method development for mercury speciation, with new methods for detecting elemental and inorganic mercury at low levels, being successfully developed. The method has been tested at the Cape Point Global Atmospheric Watch station, as a pilot study. The group is currently developing this method for other mercury species. Capacity is also being developed on a new technique to study the impact of humic acids on mercury and methylmercury bioavailability.

ESKOM: Funded internally by ESKOM, studies focus on the different mercury species emitted during coal combustion processes in electricity generation, since it is likely that species other than oxidized and particulate mercury is released during coal combustion.

The SAMA Programme envisages that in ten years from now, a completed baseline study will provide South Africa with a comprehensive view of mercury measurements in the country. Baseline data will be updated continuously and disseminated throughout a proposed mercury monitoring network.

C6 - Contribution from USA

U.S. Partners (to date): U.S. Environmental Protection Agency (USEPA) (Facilitator), U.S. National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Energy (DOE), U.S. Geological Survey (USGS), Electric Power Research Institute (EPRI), Biodiversity Research Institute Center for Mercury Studies (BRI), Dartmouth College Superfund Research Program and the National Atmospheric Deposition Program (NADP).

USEPA will share speciated measurements of atmospheric mercury (elemental mercury, Hg); reactive gaseous mercury, RGM; and particulate mercury, HGP) together with particulate matter and other criteria pollutants for years 2002- 2009 , taken at the U.S. National Oceanic and Atmospheric Administration's high altitude station at Mauna Loa, Hawaii. (More recent EPA data are available through the National Atmospheric Deposition Program and the NOAA Air Resources Lab). To this end, a notice of availability has been posted on the UNEP web site (www.unep.org) as well as the Transport and Fate Research Partnership website (http://www.iia.cnr.it/index.php?option=com_content&view= article&id=479&Itemid=40&lang=it) which directs interested parties to prepare a short letter of interest in these data and willingness to collaborate with EPA and the Partnership. Potential uses of these data include: (1) develop better understanding of the transformation and fate of globally cycled mercury, including trans-Pacific transport, thru modeling; (2) further atmospheric process research by elucidating high altitude processes impacting mercury transformation and fate; (3) link with other data from other global baseline mercury measurement stations; (4) help accumulate a long-term record of mercury species; and (5) support model development and evaluation.

USEPA will share a modeling methodology, now being developed by Harvard University under contract to USEPA, that relates global emission inventories to changes in fish concentrations in various marine regions of the world. The methodology links emissions to exposure by integrating a global transport model, an ocean model and a fish model. The methodology is being developed in the context of the Pacific Ocean sector but can be modified for use in other sectors and is expected to be published in 2015.

USEPA will participate in additional monitoring, source receptor modeling and training activities as circumstances and resources permit, participate in various meetings among Global Partnership partners that would be facilitated by Italy (the lead country) and contribute to various reports under the Partnership. At Italy's request, USEPA will arrange teleconferences among Global Partners.

USEPA, NOAA, the National Atmospheric Deposition Program and partners in East and Southeast Asia are cooperating to form an Asia-Pacific mercury monitoring pilot network. USEPA, NOAA, and NADP are providing training to strengthen capacity of participating countries to monitor ambient and wet-deposition mercury, coordinate protocols and SOPs across sites and programs, and assure high quality measurements for such efforts. Three pilot monitoring stations in Thailand, Vietnam, and Indonesia will begin operations in 2014.

NOAA will 1/share its monitoring data, through a web link to be placed on the Partnership website, for three new long-term mercury monitoring stations within the U.S. that will measure ambient concentrations of mercury species as well as other pollutants, e.g., SOx and PM, as well as mercury deposition 2/ continue to provide worldwide meteorological data through the READY web-based information system and various models for computing atmospheric trajectories and dispersion, including HYSPLIT and 3/ participate in additional monitoring, modeling and training activities, including technical advice to other countries on developing a mercury monitoring strategy.

USDOE's National Energy Technology Laboratory (NETL) will 1/ share atmospheric monitoring data it has collected within the U.S. and information about sampling and monitoring methodologies. 2/ continue its mercury work in China, developing and, after consultation with Chinese collaborators, sharing project information as deemed appropriate. As part of the latter project, NETL will maintain its ongoing partnership with the Chinese Ministry of Science and Technology (MOST) and Zhejiang University, which includes developing mercury emission factors for estimating emissions from coal-fired plants. To this end, speciated measurements have been taken at a sample of Chinese plants having different technologies. The dialogue with the Italian-led Suzhou project will be continued.

The USGS will share its World Coal Quality Inventory (Tewalt et al., 2010; http://pubs.usgs.gov/of/2010/1196/) a database of 1.580 samples of mercury (and other) contaminant concentrations from more than 57 country collaborators as well as data for more than 7,400 samples of US coal. USGS data were used to develop DOE's mercury emissions inventory for China (Streets et al., 2005). In addition, the USGS will make available a new study of mercury in South African feed coals used for power generation, prepared under the UNEP Mercury in Coal Partnership area and published jointly by UNEP and the USGS.

EPRI will expand its atmospheric mercury measurement program to better understand transboundary transport through continued support of high altitude ground-based monitoring (Mt Bachelor, Oregon) and aircraft soundings, including an investigation of in-cloud processing of mercury in marine and continental environments. EPRI will continue its mercury global and regional modeling, using the "one atmosphere" models as well as studies on mechanisms. EPRI will also continue work on background mercury fluxes, including work at various impacted and natural sites and undertaking aircraft measurements to elucidate natural sources of emissions, e.g., volcanoes and wildfires. Finally, EPRI will continue its support for the Mercury Deposition Network (MDN) data analysis, data quality, data interpretation and data measurement

programs and will investigate further initiation of a background site in California. Results will be shared with the Partnership by posting reports at www.epri.com.

BRI will contribute its North American Hg database and use it as a platform for compiling a Global Biotic Mercury Synthesis (GBMS) database using existing and available published and unpublished datasets (www.briloon.org). These data will identify both global biological Hg hotspots and data gaps. BRI conducts ecological Hg assessments across the western hemisphere to determine exposure and effects of Hg on biota. When sources can be identified emissions and effluents can thereafter be managed and conceivably economized in cases where there is governmental oversight using existing regulations. BRI contributes to multiple networks within the western hemisphere, including oversight with regional North American workshops and long-term monitoring programs. BRI is contributing to the formation of the national mercury monitoring network (MercNet), which is proposed to be the comprehensive and standardized program for monitoring spatial gradients and temporal trends of Hg in the United States, is a potential template for global policy makers to monitor and evaluate the success of national Hg emission reductions through measurements in biota..

C-MERC (Coastal and Marine Mercury Ecosystem Research Collaborative, http://www.dartmouth.edu/~toxmetal/C-MERC/index.html) sponsored by the Dartmouth Superfund Research Program brought together experts in marine mercury research and policy stakeholders to collaborate on a series of scientific papers on fate, cycling and uptake of mercury in ocean systems and human exposure to mercury world-wide and to identify the science needed to inform policy. Over 70 authors contributed to eleven peer-reviewed papers: nine published in a special issue of the journal Environmental Research which provide a synthesis of the science on pathways of mercury from sources to the seafood in specific marine ecosystems; two additional papers on the health effects of methylmercury were published in Environmental Health Perspectives. Sources to Seafood: Mercury Pollution in the Marine Environment, a companion report synthesizing the C-MERC papers for policy maker was published in December 2012. Over 300 copies of the report were distributed at the 5th session of the United Nations International Negotiating Committee on a global, legally binding agreement on mercury in Geneva Switzerland in January 2013. The report was also made available at the ICMGP 2013 meeting in Scotland. The C-MERC papers and report continue to be available at the Dartmouth Superfund Research Program website.

C7 - Contribution from UNEP

Development of Emission Inventories

UNEP with support from the Government of Denmark recently updated the 'Toolkit for Identification and Quantification of Mercury Releases' based on initial experiences in using the toolkit. The toolkit is a key information gathering tool available to countries in assessing their national situation.
Contact person: Gunnar Futsaeter, UNEP Chemicals.

UNEP Emissions Reports

UNEP has collaborated with the partnership on the development of the UNEP Emissions Report required under Governing Council Decision 24/3 IV, paragraph 24. A final report was delivered to all countries prior to the 25th session of Governing Council. The F&T partnership produced a mercury assessment report *[Pirrone, N. and Mason, R. (2009) Mercury Fate and Transport in the Global Atmosphere: Emissions, Measurements and Models. Springer, USA. pp.637 - A report of the UNEP-Global Partnership on Atmospheric Mercury Transport and Fate Research, Geneva]* that has feed into the UNEP emissions report as a major contribution. In addition, the partnership, through its chair has participated in a 'Coordination Group' responsible for overseeing the process of developing and delivering the 2013 UNEP report, and for the coordination and harmonization as far as possible of the activities under the F&T partnership, AMAP and UN ECE HTAP.
Contact Person: Gunnar Futsaeter, UNEP Chemicals.

Appendix D - List of Partners (under revision)

Other partners are welcome to join the partnership at anytime.

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