REFLECTING ON PROGRESS SINCE THE 2005 NARSTO EMISSIONS INVENTORY REPORT

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Introduction

- NARSTO was a public/private partnership that worked towards improved air quality management in North America
- The 2005 publication “Improving Emission Inventories for Effective Air Quality Management Across North America: A NARSTO Assessment” sought to identify the strengths and weaknesses of North American emissions inventories
- That process yielded eight key elements for improvement
- What has happened since then?

What was included?

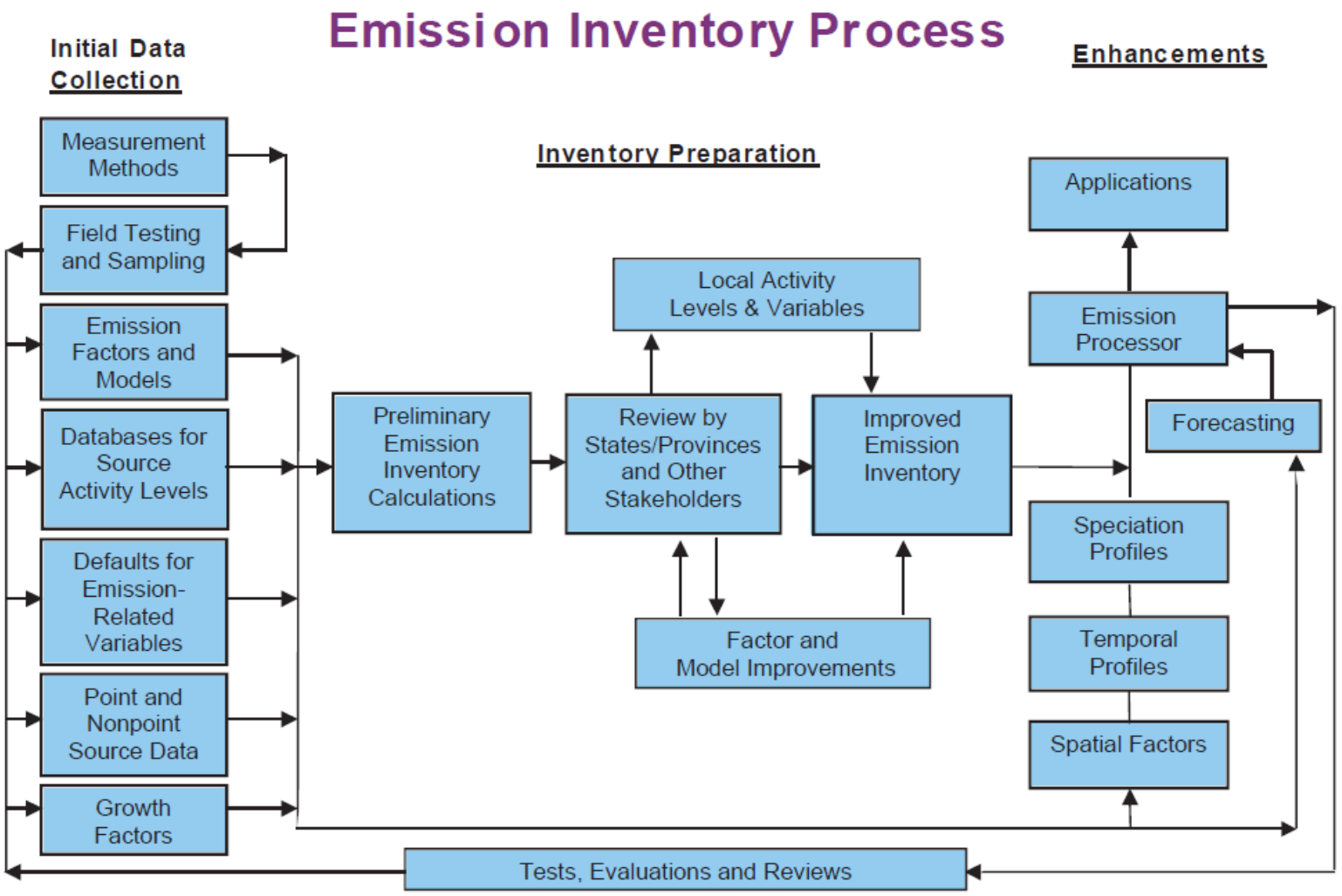


Figure 2.1. Emission Inventory Development

What was included?

1. Reduce uncertainties associated with emissions from key under-characterized sources.
2. Improve speciation estimates.
3. Improve existing emission inventory tools and develop new ones.
4. Quantify and report uncertainty.
5. Increase inventory compatibility and comparability.
6. Improve user accessibility.
7. Improve timeliness.
8. Assess and improve emission projections.

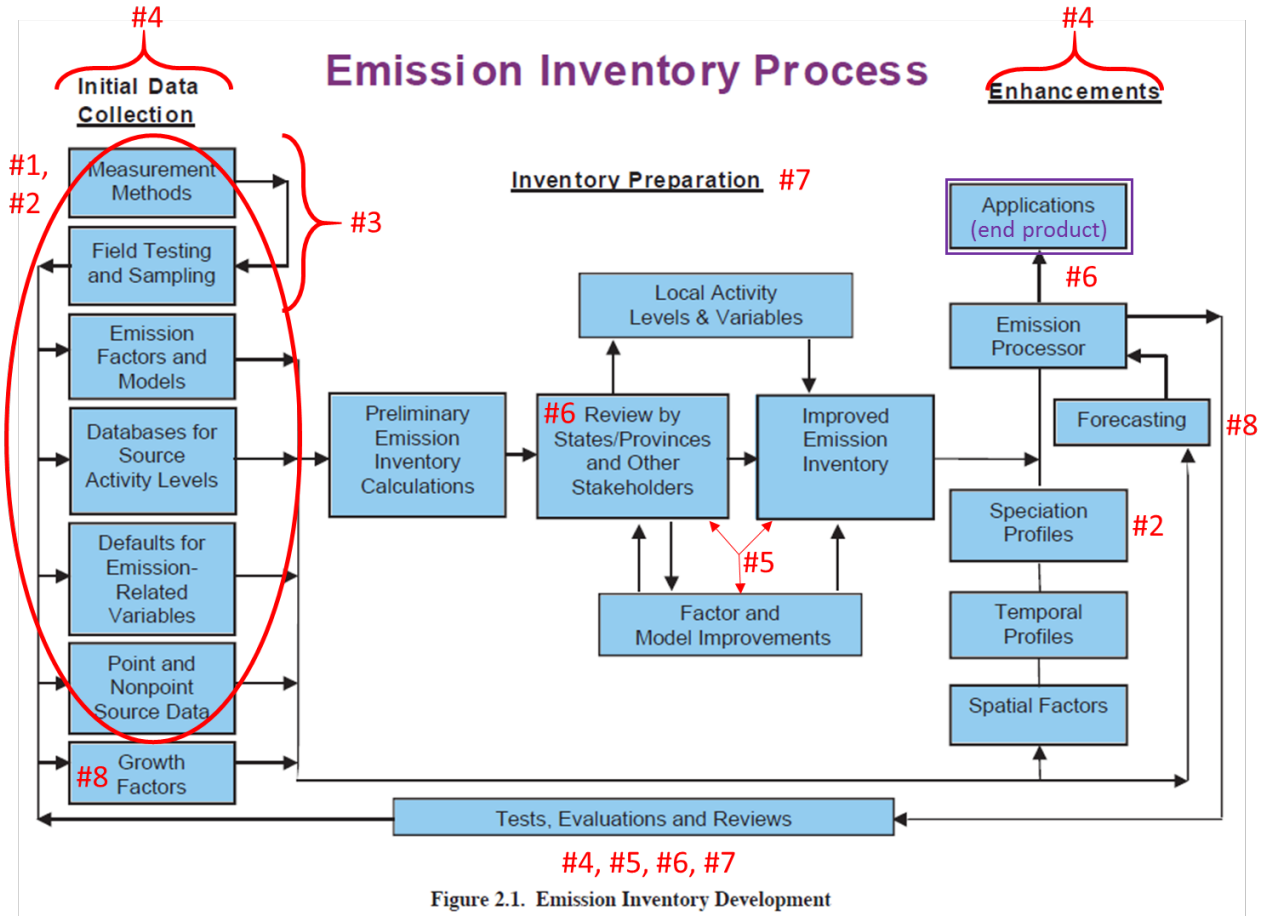


Figure 2.1. Emission Inventory Development

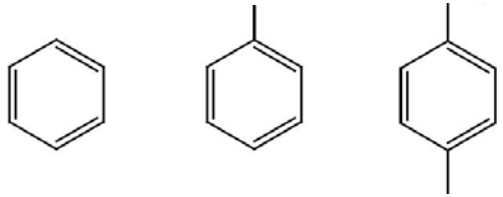
Scope of this update

- Original NARSTO assessment covered emissions inventory quality throughout North America, but today we'll focus mostly on the US
- Criteria pollutants (NO_x, NH_3, SO_2, CO, VOCs, and particulate matter (PM)), criteria precursors, and some hazardous air pollutants (HAPs):
  - The U.S. National Emissions Inventory (NEI) is released by EPA Office of Air Quality Planning and Standards (OAQPS)
  - Reports county-level annual emissions totals for the pollutants every three years based on SLT data
- Other toxic chemicals:
  - If not voluntarily provided by SLTs, HAPs in NEI taken from a parallel data set called the Toxic Release Inventory (TRI)
- Greenhouse gases (GHGs):
  - Some GHGs have been added to the NEI recently
  - The EPA Office of Atmospheric Programs also produces two datasets:
    - The Greenhouse Gas Reporting Program (GHGRP) for annual facility-level reporting
    - The Inventory of U.S. Greenhouse Gas Emissions and Sinks (GHG Inventory) reports national-level data to the UN Framework Convention on Climate Change

1) Reduce uncertainties for key under-characterized sources

- **NARSTO Recommendation:** Focus immediate measurement and development efforts on areas of greatest known uncertainty, systematically apply sensitivity and uncertainty analyses to identify subsequent improvement priorities.
- **Update:**
- Several sources have received significant research support:
  - Fine particle and onroad motor vehicle emissions are much more well-documented, although more organic precursor research is needed
  - Open biomass burning and residential wood combustion are better characterized, and fire inventories are produced yearly
  - Biogenic VOC characterization and simulation has improved
  - Agricultural ammonia was topic of several research grants
- Continued updates are necessary as the relative contribution of pollutants changes over time (e.g. unconventional oil&gas)
- Research to improve emissions characterization could have a more straightforward path towards incorporation into the inventory

2) Improve speciation estimates

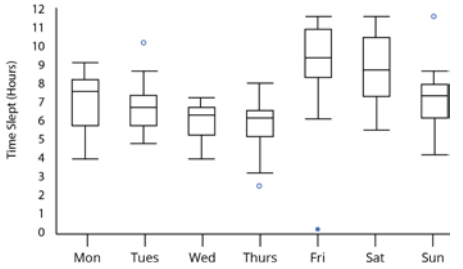


- **NARSTO Recommendation:** Develop new and improve existing source speciation profiles and emission factors
- **Update:**
- Since 1988, EPA has produced a database called SPECIATE, which now provides 5,728 speciation profiles for emissions of particulate matter (PM), volatile organic compounds (VOC), and other gases
  - SPECIATE is now available online with a user interface
  - New source profiles have been added and updated since 2005 (e.g. wildfires)
  - Important to continue to update this database with more information as it becomes available, especially as new sources of emissions, new control technologies, and new measurement techniques emerge

3) Improve existing inventory tools and develop new ones

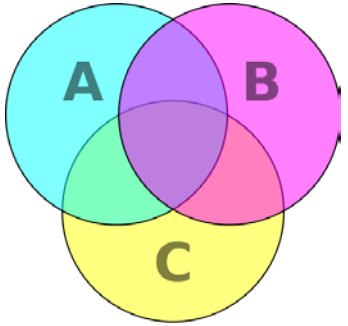
- **NARSTO Recommendation:** Apply new technological capabilities to allow models to more closely approximate actual emissions
- **Update:**
- Newer sensors and equipment can identify species in much more detail, e.g. satellites and personal sensors
- Need to continually address how to incorporate new measurements and tools into emissions inventories
  - e.g. top-down satellite data suggest the NOx from MOVES is too high, but does not offer enough source detail to explain why
- New technology and techniques are complementary to existing work; comparing and contrasting techniques is recommended

4) Quantify and report uncertainty



- **NARSTO Recommendation:** Develop guidance, measures, and techniques to improve uncertainty quantification, and include measures of uncertainty as a standard part of reported emission inventory data.
- **Update:**
- Qualitative advances have been made in some areas
  - WebFIRE is an online database of criteria pollutant emissions factors that supplements existing AP-42 documents, can calculate uncertainty based upon emissions test characteristics and applications
  - The Community Emissions Data System (CEDS), an updated historical (1750-2014) emissions time series, is planning to create uncertainty estimates for their global inventory
- Uncertainty is more relevant for research and planning (How robust is the choice of control strategy?) than for policy
- More inclusion and quantification of uncertainty and metadata is recommended

5) Increase inventory compatibility and comparability



- **NARSTO Recommendation:** Define and implement standards for emission inventory structure, data documentation, and data reporting for North American emission inventories.
- **Update:**
- Publicly available documentation has become more common, through online access and more detailed technical support
- Opportunities for improved consistency between the NEI and GHG inventories, with consideration that both inventories are built for different purposes
- Harmonization or comparison of different emissions inventories across North America is an ongoing challenge, with some success
  - Canada and Mexico have GHG and criteria reporting
  - Global Emissions InitiAtive (GEIA) is working to improve access to global and regional emissions datasets
  - Global datasets available from EDGAR, HTAP, and CEDS

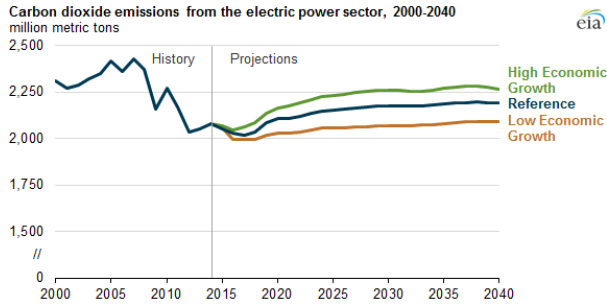
6) Improve user accessibility

- **NARSTO Recommendation:** Improve user accessibility to emission inventory data, documentation, and emission inventory models through the Internet or other electronic formats.
- **Update:**
- Increases in computing power and online access have helped user accessibility significantly
  - More documentation
  - More online emissions submission portals (NEI/GHGRP)
  - Downloadable datasets and models (NEI, SMOKE, MOVES)
- Inventory system is still complex and can require background knowledge to navigate documentation and portals

7) Improve timeliness

- **NARSTO Recommendation:** Create and support a process for preparing and reporting national emission inventory data on a yearly basis.
- **Update:**
- The NEI has continued to release an update every three years; more frequently would be impractical because of resources required
- The GHG Inventory is submitted every year, as required, although smaller than NEI
- Having a multi-year inventory with consistent methodology would make long-term retrospective analysis easier and encourage use of existing inventories
  - Researchers at EPA have produced a 1990-2010 gridded emissions inventory for regional chemical transport modeling
  - Community Emissions Data System (CEDS) provides global 1750-2014 emissions

8) Assess and improve emission projections



- **NARSTO Recommendation:** Emission projection methodologies for all emission inventory sectors in North America should be evaluated to determine the accuracy of past projections and identify areas of improvement for future projections.
- **Update:**
- Variety of projections produced:
  - EPA-projected inventories are generated for modeling specific criteria pollutant rules, typically shorter term projections (i.e. 5-10 years)
  - National-scale GHG projections are submitted in the US Biennial Report to the UNFCCC on longer-term time frames (i.e. projecting to 2050, 2100)
  - IPCC publishes activity and GHG projections on a global scale
  - Some users produce their own projections, but may lead to debates about consistency and accuracy
- Assessing accuracy of past emissions projections can inform future projections, continues to be a significant research need

Conclusions: Improvements

- The 2005 NARSTO publication issued 8 suggestions for emissions inventory improvement and all have been explored to some degree in recent years
- The US NEI and GHG inventories have become more detailed than ever before, incorporating new research into previously undercharacterized sources (e.g. fine particles and biomass burning)
- Speciation estimates from sector emissions have improved
- Some studies have looked into quantifying uncertainty in the NEI and other emissions sources
- It is easier to access the inventory and many emissions tools via the internet than it was in 2005

Conclusions: Opportunities

- Undercharacterized emissions sources remain due to complexities in measurement or shifting sector priorities
- Other research into speciation, uncertainty, and comparability must continue as the field evolves
- Increased coordination may be possible on several levels
  - Researchers and inventory developers could work together more often to ensure that research is relevant
  - Could analyze intra-agency consistency between inventory groups
  - Inter-agency coordination can improve how inventories are used throughout government - e.g. the Combined Air Emissions Reporting (CAER) and Technical discussions on Emissions and Atmospheric Modeling (TEAM) groups
- The recent NSF-commissioned National Academies report on atmospheric chemistry identifies emissions as a top science priority
- The scientific community and government agencies need to continue to leverage resources and collaborate

Suggestions? Questions?

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