The Role of Air Emission Inventories

Judy Rand, NJDEP, May 17, 2023

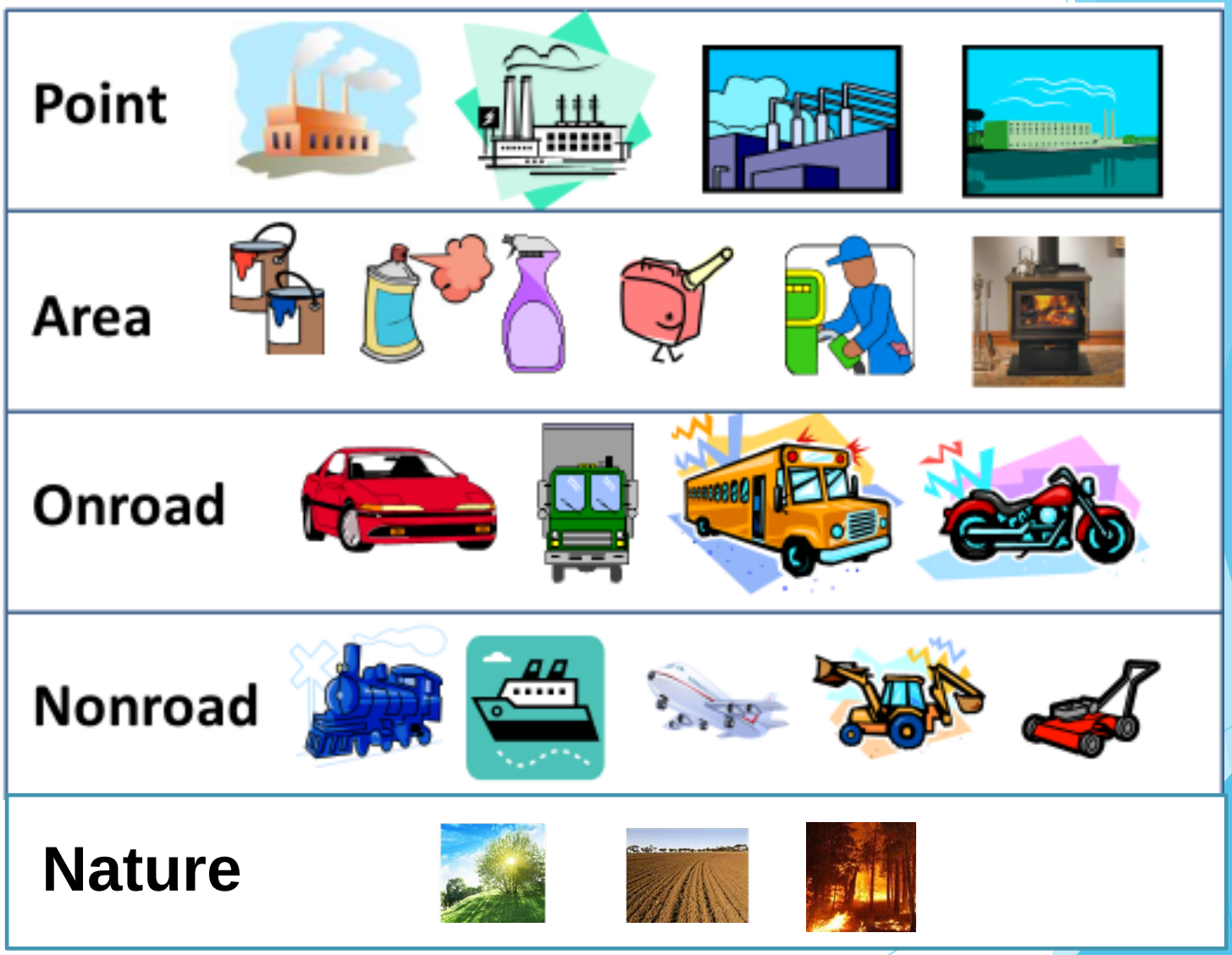
What is an air emissions inventory?

- A compilation of estimated emissions from sources of anthropogenic (human-made) and biogenic (natural) air pollutants emitted from various sources

- **Criteria Air Pollutants (CAPs):**
  1) Ozone precursor pollutants primarily VOC and NOx, also CO
  2) Particulate Matter 2.5 and 10 and precursor pollutants, primarily SO2 and NOx, also ammonia and VOC
  3) Lead
  4) Sulfur Dioxide
  5) Nitrogen Dioxide
  6) Carbon Monoxide

- **Hazardous Air Pollutants (HAPs)**

Emission Inventory Source Categories



Statutory Provisions

CAA 110(a)(2) Infrastructure Inventory Requirements

- NAAQS emission reports, modeling, visibility and public hearing requirements

CAA 172(c)(3) NAA SIP Requirements for CAP

- Periodic emission reports

CAA 175A Maintenance Plan

- Maintenance plan inventory requirements

CAA 182 Ozone NAA Inventory Requirments

- 182(a)(3) Periodic inventory every 3 years until re-designated to attainment
- 182(b)(1) ROP and RFP inventory requirements for moderate areas
- 182(c)(2) ROP and RFP inventory requirements for serious areas

CAA 169A and 169B Regional Haze

- Visibility protection for Federal class I areas

Regulatory Requirements

Consolidated Emissions Reporting Rule (CERR) 2002

- Consolidated different inventory reporting requirements into one place(CAA Section 182, regional haze, and NOx SIP Call)
- Established PM2.5 inventory requirements
- New requirements for area and mobile sources
- Annual and three year inventories

Air Emissions Reporting Rule (AERR) 2008

- Replaced CERR
- Shortened timeline for reporting
- Eliminated biogenic reporting
- Point source definition from Title V of the Clean Air Act

AERR 2015 Revisions

- Lead reporting threshold change
- Eliminated wildfire reporting
- Mobile model input requirements
- Removed seasonal reporting requirements

Regulatory Requirements

- Ozone and $PM_{2.5}$ SIP Requirements Rules
    - Contain inventory, modeling and RFP requirements and references to AERR and inventory and modeling guidance documents.
- Regional Haze Program Requirements
    - 40 CFR 51.308 and 51.309
- "Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations, May 2017

Types of Air Emission Inventories

- **Actual**
- **Future Projection**
- **Annual**
- **Seasonal**

How are air emission inventories used?

National Emissions Inventory (NEI)

- Emissions required every year for point sources
- Required every three years for remaining sources, or accept EPA estimates
- Onroad and nonroad model inputs required, not emissions, EPA runs the models
- Annual emissions of CAPs & precursors and HAPs
- Seasonal emissions are voluntary
- Electronic submittal to EPA's Emission Inventory System (EIS)

SIP Requirements for Criteria Air Pollutants

Periodic Inventories for Nonattainment Areas:

- Required regardless of classification
- Actual annual emissions and/or seasonal based on pollutant
- May be satisfied with NEI submittal without a public hearing if:
  - approved by local EPA region
  - seasonal "emissions" are submitted to EIS as required for all sources including mobile (NEI only requires inputs for models)
  - does not have "regulatory significance" (RFP, attainment demonstration or maintenance plan)
  - however, EPA notes that this could be challenged in court as failing to follow the CAA

SIP Requirements for Criteria Air Pollutants

Attainment Demonstration Modeling:

- Moderate areas and above
- Actual annual and future projection annual emissions input into model
- Spatially and temporally allocated by the model
- Chemically speciated by the model

SIP Requirements for Criteria Air Pollutants

Reasonable Further Progress (RFP) Control Measure Demonstration:

- Moderate areas and above
- Actual and future projection emissions
- Annual and/or seasonal based on pollutant
- Summarize precursor emissions and emission reduction benefits from State and Federal rules
- Show that progress from control measures meets RFP
  - Moderate: 15% emission reduction over 6 years
  - Serious and above: 18% over 6 years, 3% /year thereafter

SIP Requirements for Criteria Air Pollutants

Redesignation Requests:

- Attainment, interim and future projection year emissions at least 10 years out
- Annual and/or seasonal based on pollutant
- Summarize emissions and emission reduction benefits from State and Federal rules
- Show that emissions are decreasing in the future, otherwise have to model to show that area will not exceed NAAQS in future

Planning

- Identify largest contributor pollution sources currently and in future
- Evaluate existing control programs
- Evaluate trends
- Research new control measures
- Estimate emissions reductions from control measures

Other

- Regional Haze Plans and Reports
  - Modeling
  - Base year and current year emissions
  - Show reductions from relevant sources
- USEPA uses NEI for Transport Rule Modeling
- Administer emission-based fees for point sources
- Respond to public information requests

How are air emissions calculated?

“Actual” Air Emissions:

- Actual air testing; or
- Emissions =Activity * Emission Factor * Control Factor

Control Factor = (1-(Control Efficiency*
Rule Effectiveness*Rule Penetration))

“Projected” Air Emissions =

Actual Emissions *
Growth Factor from Base Year to Future Year *
Control Factor

Actual Inventory Calculation Methods

- **Point Sources:**
  - Facilities report through the Emission Statements Program
- **Area Sources, Marine and Rail**
  - Estimated using activity and emission factors
- **Onroad, Nonroad Equipment and Aircraft**
  - Models (EPA, FAA), Actual and Projection
- **Biogenic**
  - BEIS Model or Megan Model, Actual and Projection

Actual Inventory Calculation Methods

Point Sources

- Facilities report through the Emission Statements Program
- Emissions Statement Applicability in New Jersey:
  - 5 tons per year Pb
  - 10 tons per year of VOC
  - 25 tons per year of NOx
  - 100 tons per year of carbon monoxide, PM2.5, PM10, SO2, ammonia, TSP

- Facility Allowable Calculation Methodologies in New Jersey
  - Continuous Emissions Monitoring
  - Emission Factors: AP-42,· State or local agency
  - Predictive Emissions Monitoring
  - Agency approved and supervised source testing
  - Material balance using engineering knowledge of the process
  - Manufacturer's Estimate or Data
  - Best engineering judgement

Actual Inventory Calculation Methods

Area Sources General

- Estimated at County or State Level Using Primary Activity Indicators
  - Primarily: Population (MPO data or Census by county), Employment (DOL by county), Fuel Consumption (SEDS state level, industrial, commercial, residential, etc…), VMT (MPOs by county)
  - Other: Waterborne Commerce (Army Corp), Lane Miles, Pesticide Usage (NJDEP), Incineration Permits, Landfill Models, Building Permits (DCA and Census), Cost of Construction (Census), Acres Tilled, # Restaurants, Ag Fire Permits, Wildfire and Prescribed Burning (Forestry), Livestock (EPA, USDA)
- State Level Data (Fuel Consumption, etc..), Allocated to County Using Secondary Activity Indicators
  - Employment, Census Data (primary heating housing units, residential housing), VMT, LTOs, Lane Miles, Precipitation, Population
- Point Source Subtraction: Fuel data, employment, emissions data

Actual Inventory Calculation Methods

EPA Area Sources Procedures

- EPA Access Database called “Wagon Wheel” with 22 calculation modules representing groups of area source SCC codes such as:
  - ICI Fuel Combustion, Residential Wood Burning, Solvents, Agricultural Tilling, Road Dust……..
- Categories not calculated in the Wagon Wheel include:
  - Oil and Gas, Fires, Biogenics, Agriculture–Fertilizer, Agriculture-Livestock Waste, Portable Fuel Containers
- Other EPA procedures:
  - NOMAD Group: Monthly calls with EPA/States
  - Nonpoint Survey
  - Input Templates
  - PM Augmentation (PM-CON, PM25-FIL, and PM10-PRI)
  - HAP Augmentation
  - Point Source Subtraction

Actual Inventory Calculation Methods

Fugitive Dust PM categories (paved and unpaved roads, construction, agriculture, etc…)

- Monitoring does not support EPA's emission estimates for fugitive dust.
- Is unadjusted in the NEI and/or regional base inventories/modeling inputs.
- Is adjusted/reduced in modeling inventories in the SMOKE model because fugitive dust doesn't transport like other pollutants.
- NJ adjusts/reduces fugitive dust in SIP inventories

Growth Factors

- Applied to base inventory to estimate future emission projections

Growth Factors

Point

- EGUs
  - ERTAC model, growth and control, AEO growth projections for electricity demand by fuel type, inputs from states on new projected units, closures, controlled emission rates, CSAPR caps
- Non-EGU Point
  - Growth Factors calculated using similar activity indicators as base inventory
    - Employment Projections, AEO Fuel Usage Projections (Mid-Atlantic, NJ-NY-PA),
- Emission Offset Bank
  - Estimated future emissions that may be purchased from the bank. Applied to future Area source inventory (spread out throughout state via population), although Point source emissions, because unknown where emissions will occur.

Growth Factors

Area

- Growth Factors calculated using same or similar activity indicators as base inventory
  - Population Projections, Employment Projections, AEO Fuel Usage Projections (Mid-Atlantic, NJ-NY-PA), VMT Projections
- Residential Wood Burning
  - EPA Residential Wood Projection Tool, growth and control
- Agricultural Ammonia
  - EPA Greenhouse Gas Tool Livestock Projections (EPA, USDA)
- Zero Growth
  - Burning and Fires, Unpaved Roads, Breweries, Wineries, Distilleries, Traffic Marking Coatings, Industrial Refrigeration, Incineration, Landfills, LUSTs, Composting, Cremation, Animals, Cigarette Smoking

Control Factors

- Applied to inventory to estimate emission reductions from control measures
- Control Factor =

  (1-(Control Efficiency*Rule Effectiveness*
  Rule Penetration))

Regional Workgroups

Work with other states and USEPA to develop regional emission inventories (MANE-VU, MARAMA, OTC, LADCO, SESARM, CENSARA, WESTAR…)

- Regional inventories are required for attainment demonstration and Regional Haze modeling
- Increased coordination with EPA and use of EPA inventories reduces duplication of efforts, more efficient, better inventories
- Increased involvement by states on reviewing EPA transport modeling inventories
- Emission Modeling Framework (EMF) Database used by MARAMA to manage regional inventories

Inventory Improvement

Point SCC Codes:

Fundamental code in inventory development, organization and evaluation

- EPA has too many
- Provide guidance to reporters
- Known issues:
  - Power plants using boiler SCC codes instead of EGU boiler SCC codes
  - Fugitive, Insignificant and Batch emissions may not be assigned to SCC codes.
  - Bulk Gasoline Storage spread out over several similar SCC codes (Bulk Plants, Bulk Terminals, Refineries, etc.…)

Inventory Improvement

Point Peak Ozone Season Inconsistent Reporting:

- Some facilities average over the total operating hours and some pick the peak day emissions from CAMD.
- Some states use five month ozone season, some use three month ozone season.

Inventory Improvement

EPA's Current List for Area Sources

Improvements always in progress, EPA NOMAD group and EPA Contractor

- Roofing asphalt
- Cooking
- Oil and gas solvents
- Agricultural silage
- Livestock waste
- Abandoned oil and gas wells
- Wildland urban interface and structural fires
- Residential Wood
- Nonpoint gasoline distribution
- Reintroduction of dioxin and furans
- Speciate database updates
- Temporal and special allocations and emission projections

Inventory Improvement

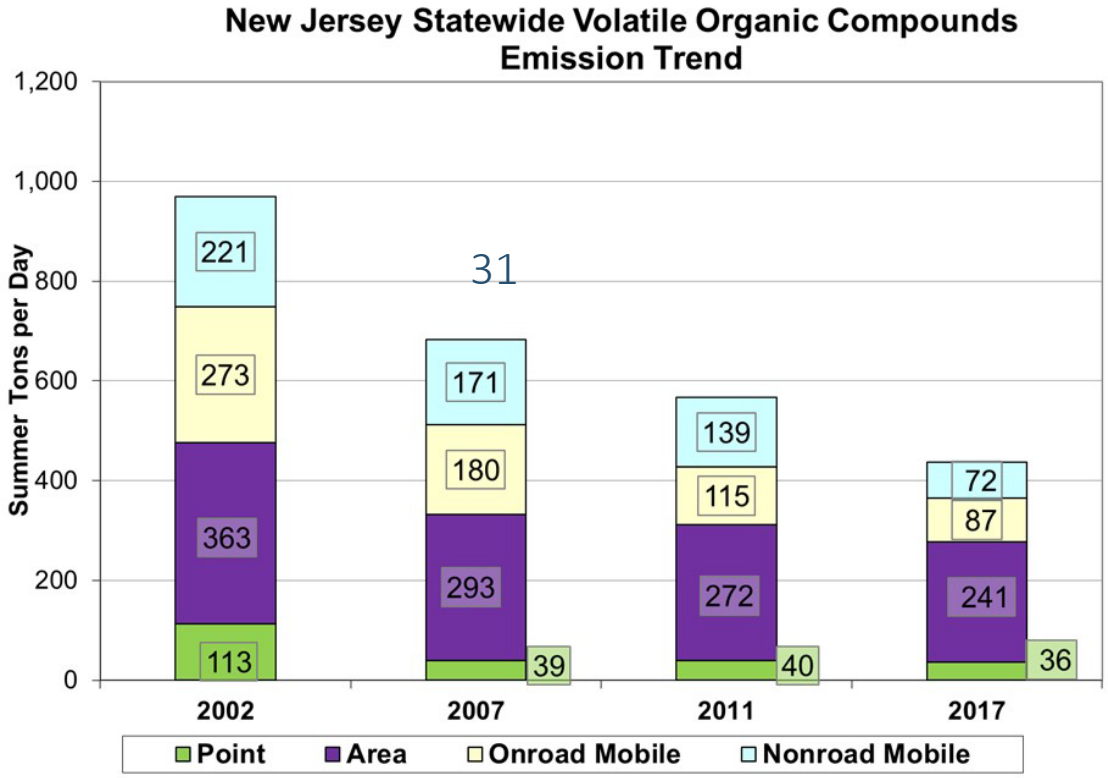
Projection Inventories:

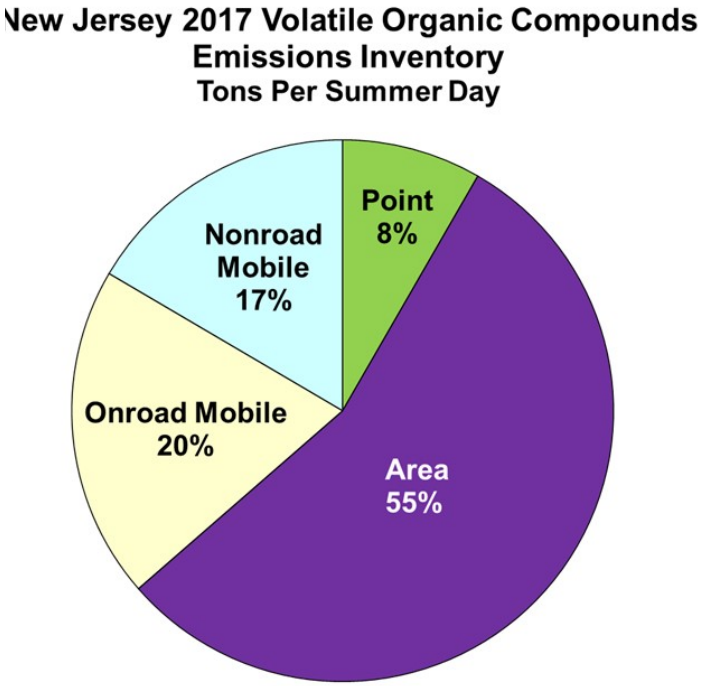
- Employment projections often at high level NAICS code and not specific enough to SCC code it is being used for

- Review growth factors using the "common sense" method based on existing permit conditions and industry growth potential at the SCC code level and facility level

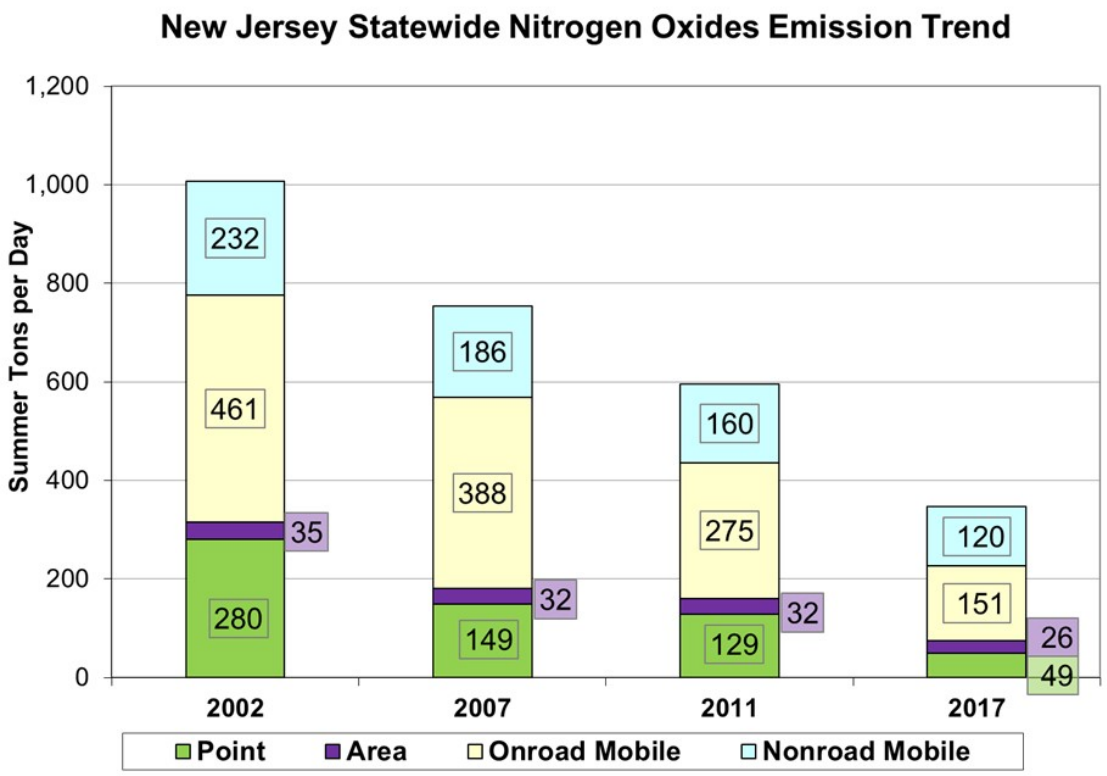
- EGU fuel growth factors not always accurate, but can't be adjusted or are very difficult to adjust

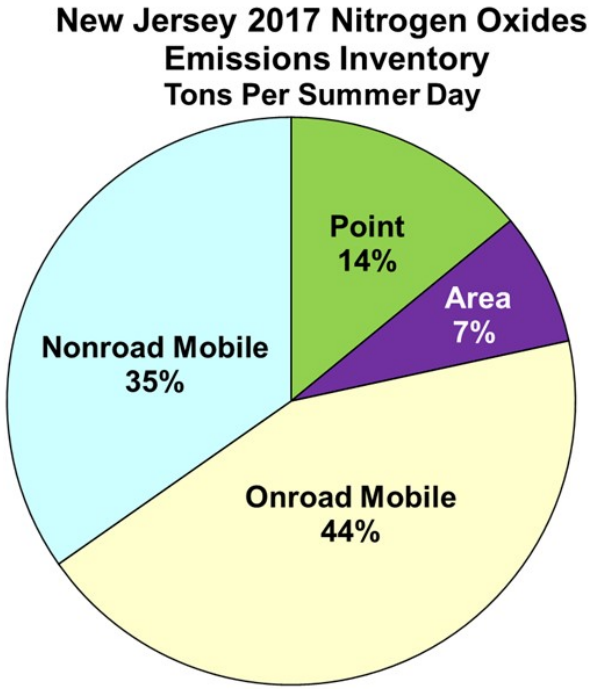
VOC Emissions



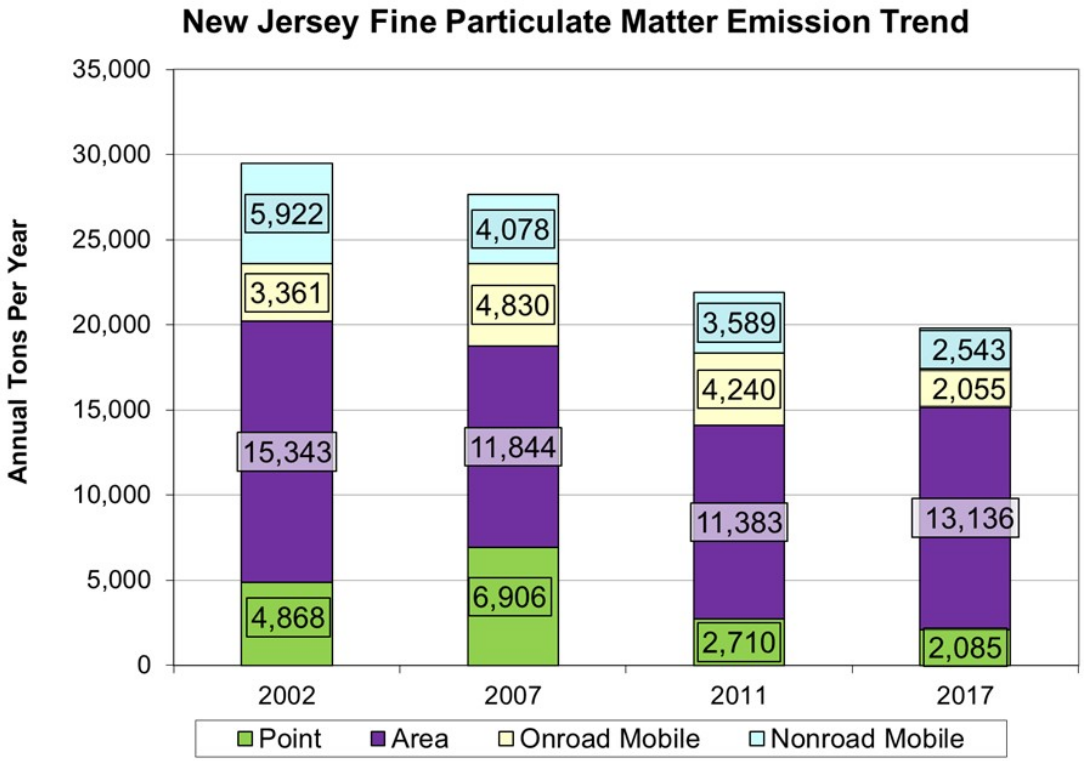


NOx Emissions

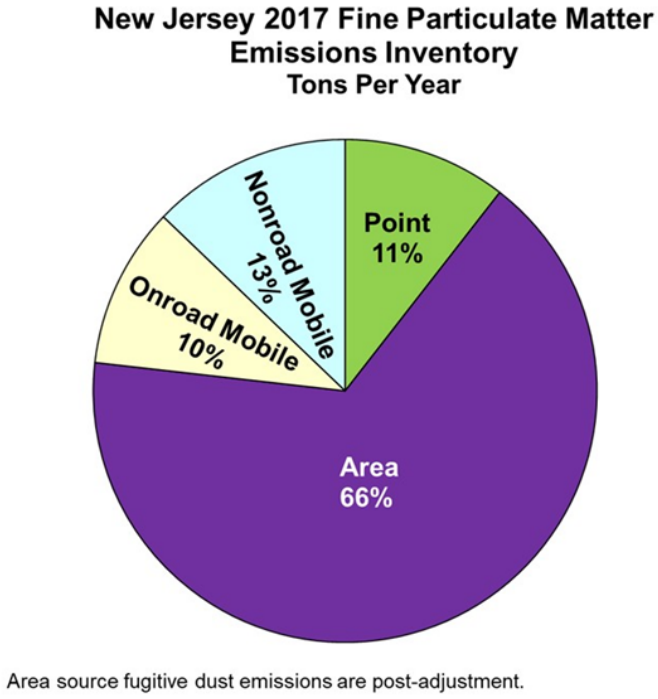




PM2.5 Emissions

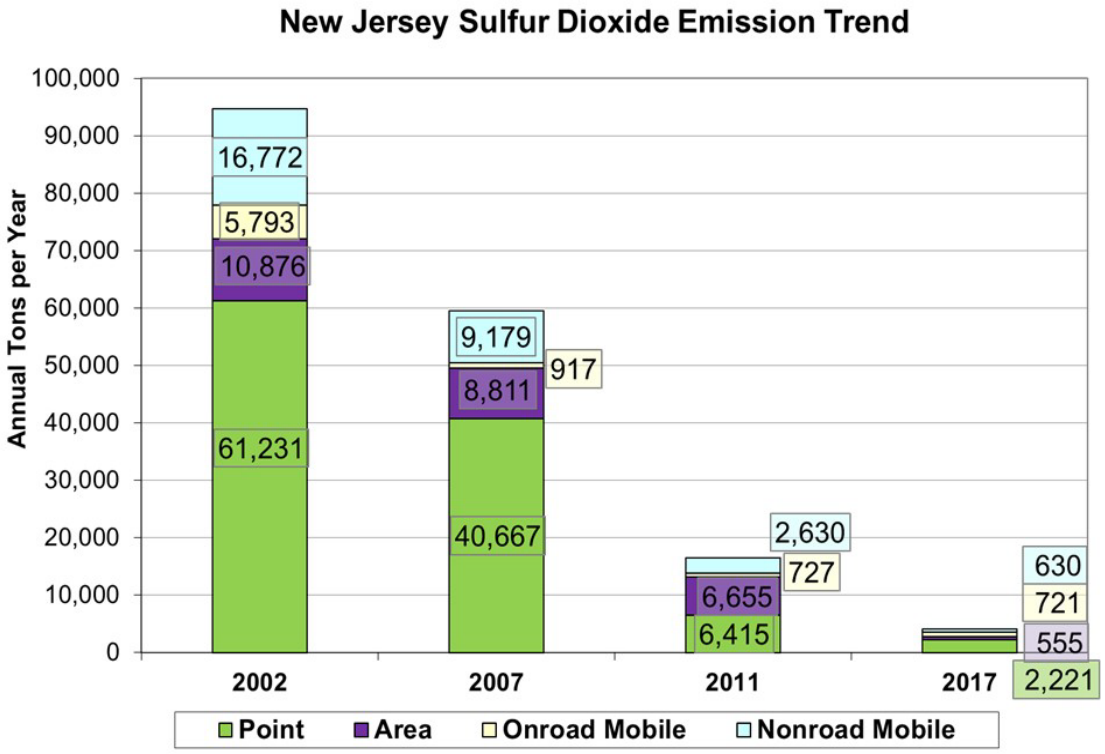


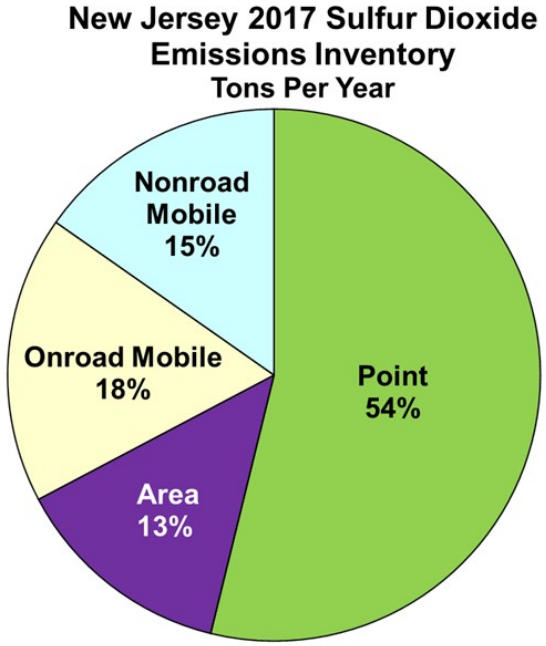
Note: Area Source fugitive dust emissions are post-adjustment.

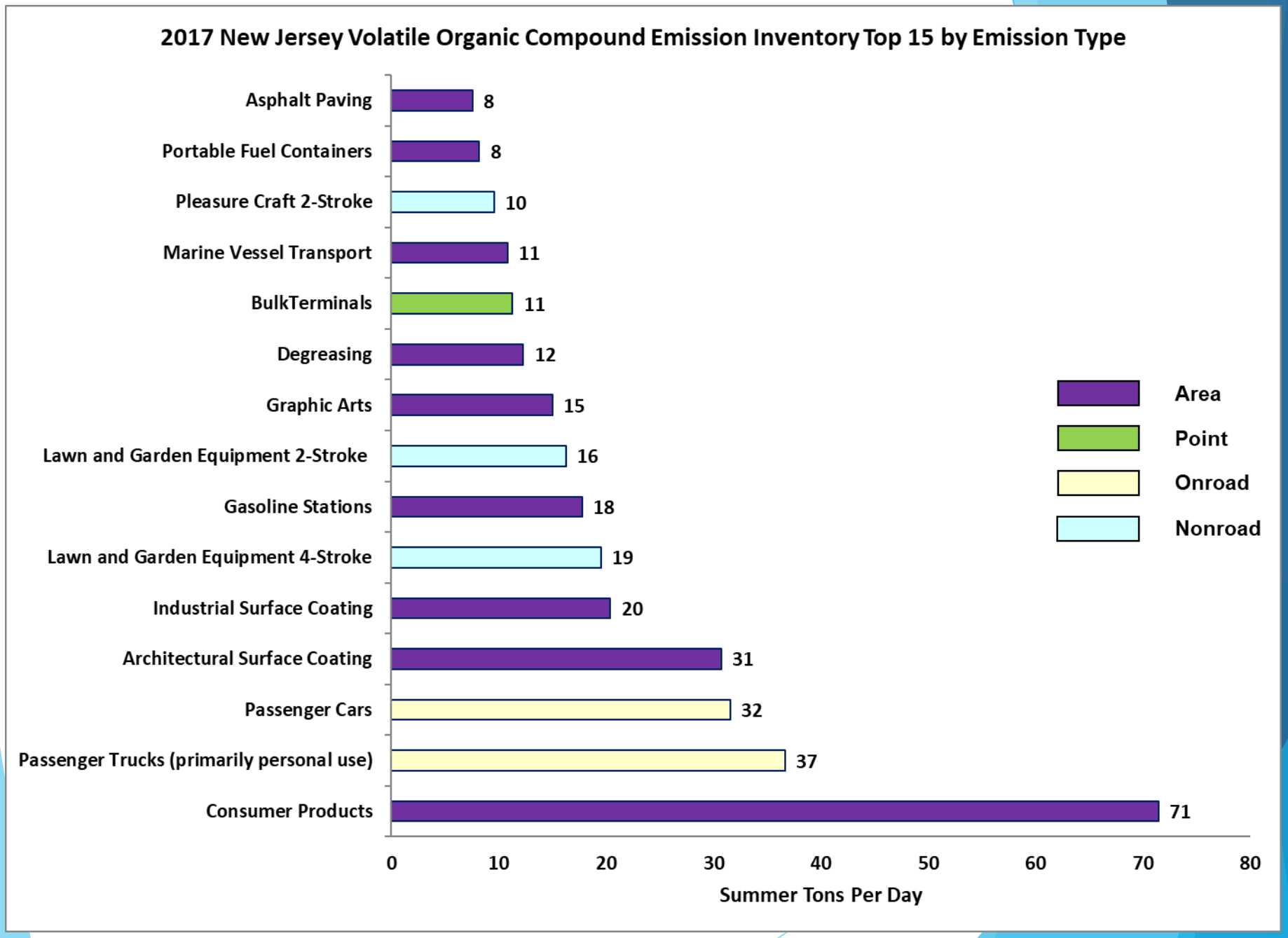


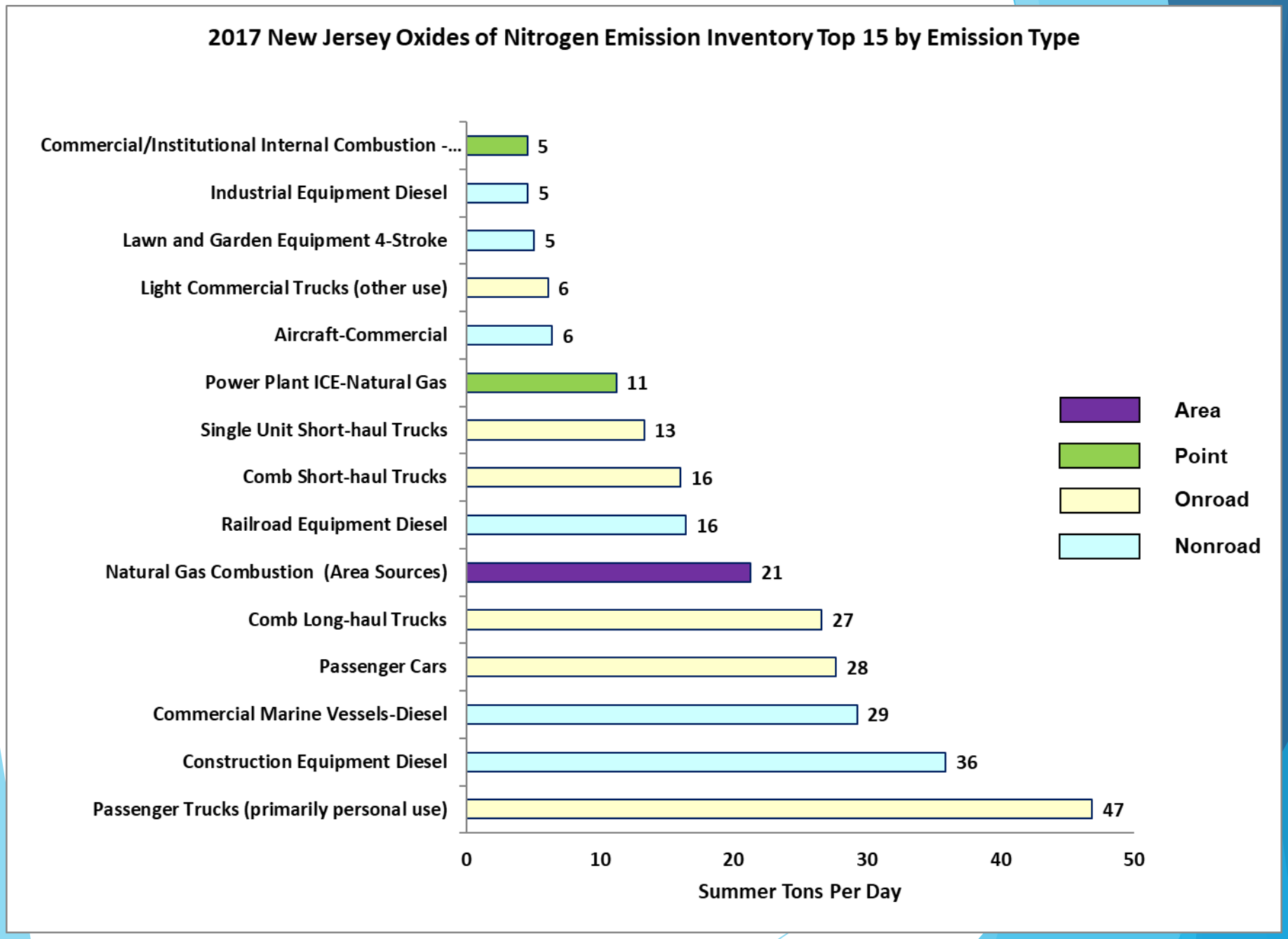
Area source fugitive dust emissions are post-adjustment.

SO_2 Emissions

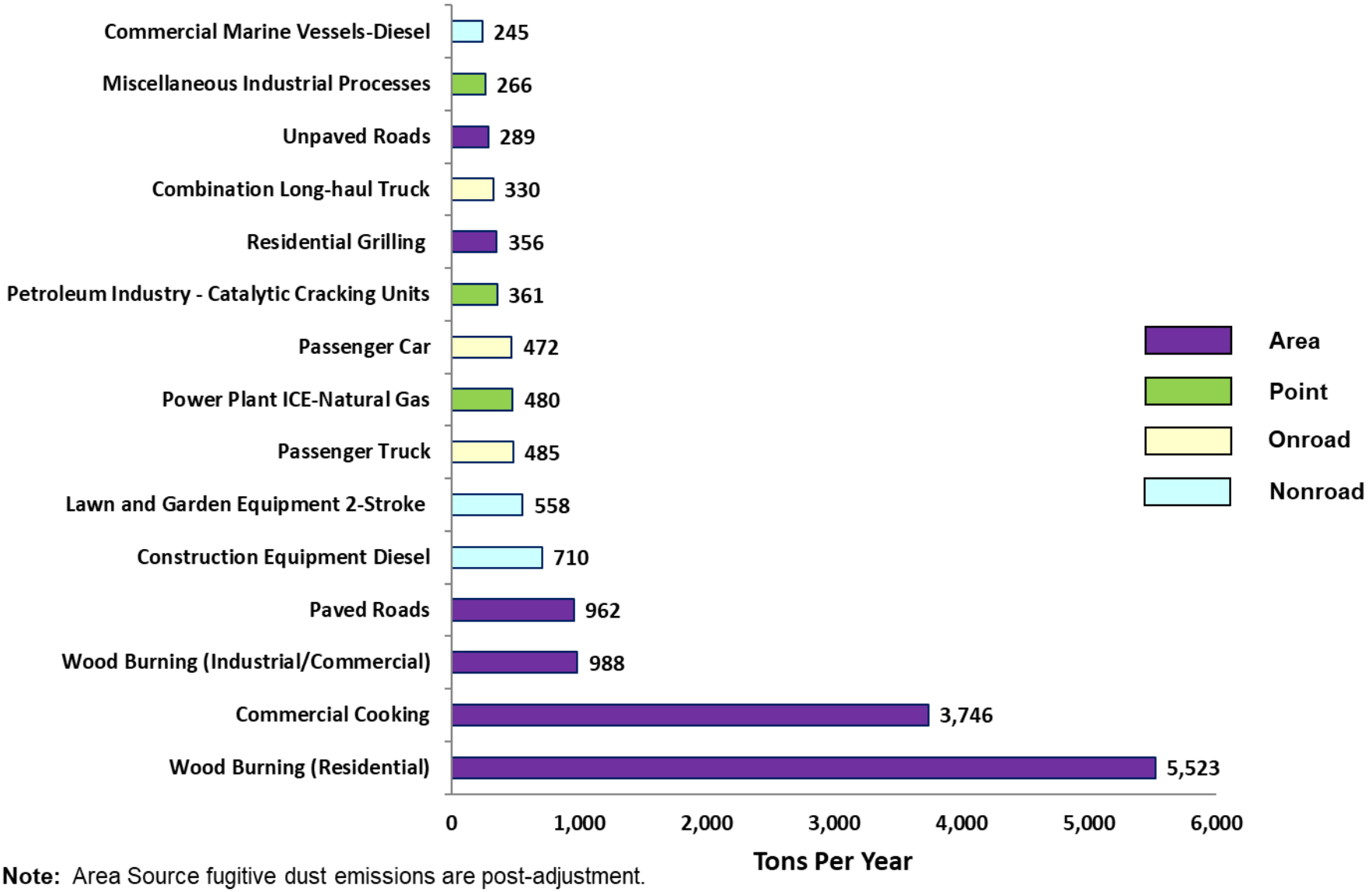





2017 New Jersey Volatile Organic Compound Emission Inventory Top 15 by Emission Type
Asphalt Paving
8
Portable Fuel Containers
8
Pleasure Craft 2-Stroke
10
Marine Vessel Transport
11
BulkTerminals
11
Degreasing
12
Graphic Arts
15
Lawn and Garden Equipment 2-Stroke
16
Gasoline Stations
18
Lawn and Garden Equipment 4-Stroke
19
Industrial Surface Coating
20
Architectural Surface Coating
31
Passenger Cars
32
Passenger Trucks (primarily personal use)
37
Consumer Products
71
Area
Point
Onroad
Nonroad
0
10
20
30
40
50
60
70
80
Summer Tons Per Day

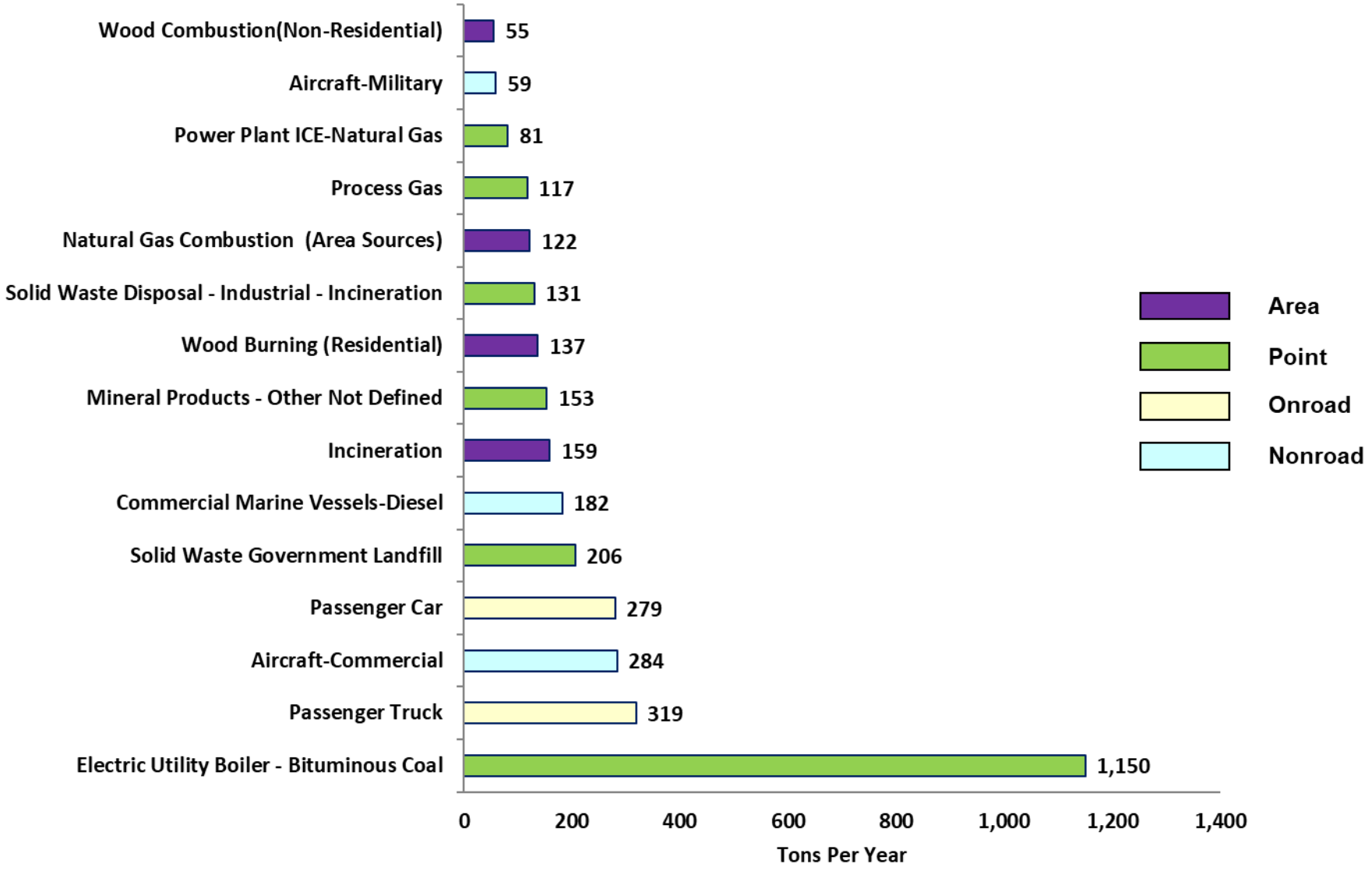

2017 New Jersey Oxides of Nitrogen Emission Inventory Top 15 by Emission Type
Commercial/Institutional Internal Combustion -...
Industrial Equipment Diesel
Lawn and Garden Equipment 4-Stroke
Light Commercial Trucks (other use)
Aircraft-Commercial
Power Plant ICE-Natural Gas
Single Unit Short-haul Trucks
Comb Short-haul Trucks
Railroad Equipment Diesel
Natural Gas Combustion (Area Sources)
Comb Long-haul Trucks
Passenger Cars
Commercial Marine Vessels-Diesel
Construction Equipment Diesel
Passenger Trucks (primarily personal use)
5
5
5
6
6
11
13
16
16
21
27
28
29
36
47
0
10
20
30
40
50
Summer Tons Per Day
Area
Point
Onroad
Nonroad

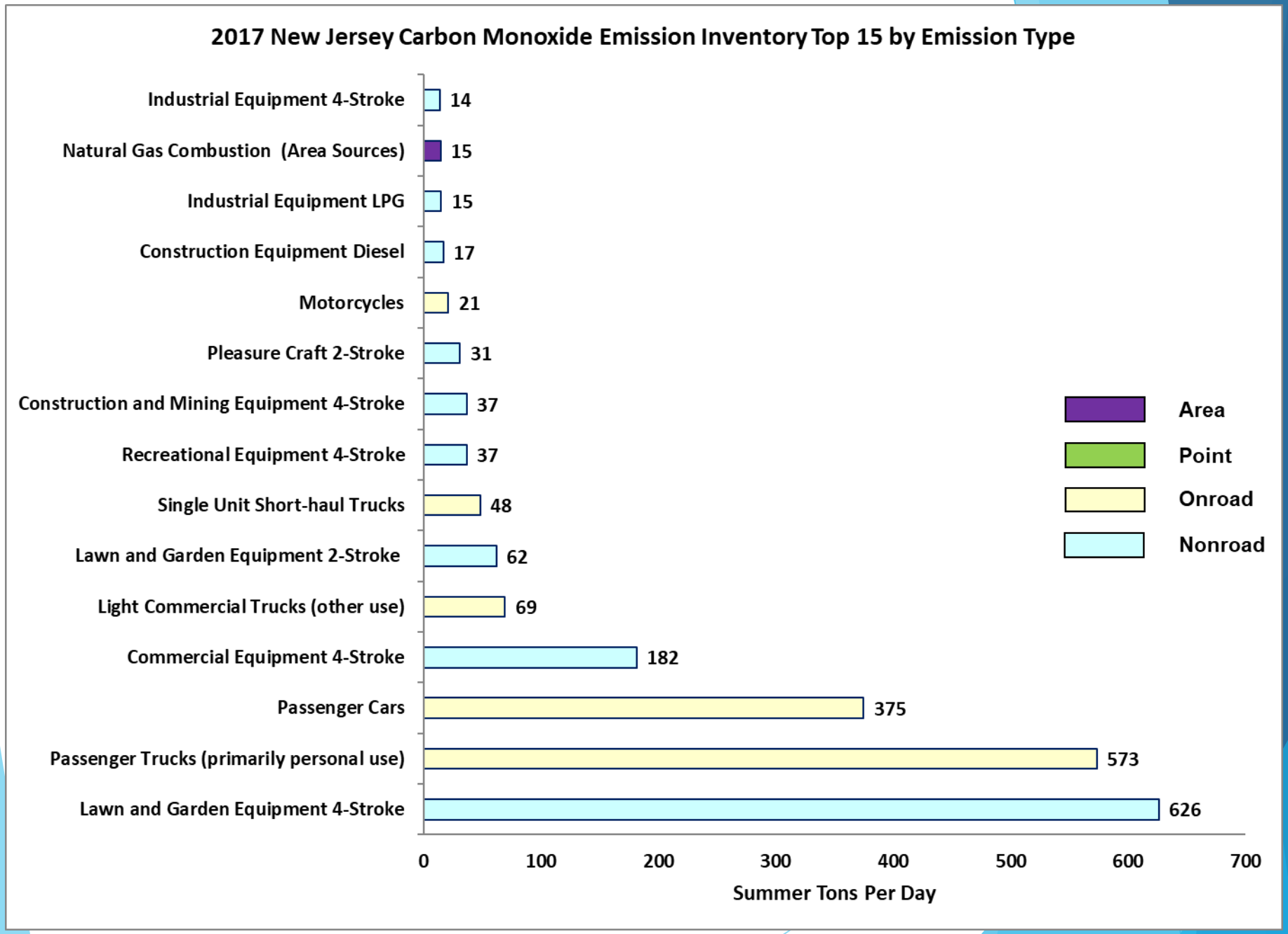
2017 New Jersey Fine Particulate Matter Emission Inventory Top 15 by Emission Type

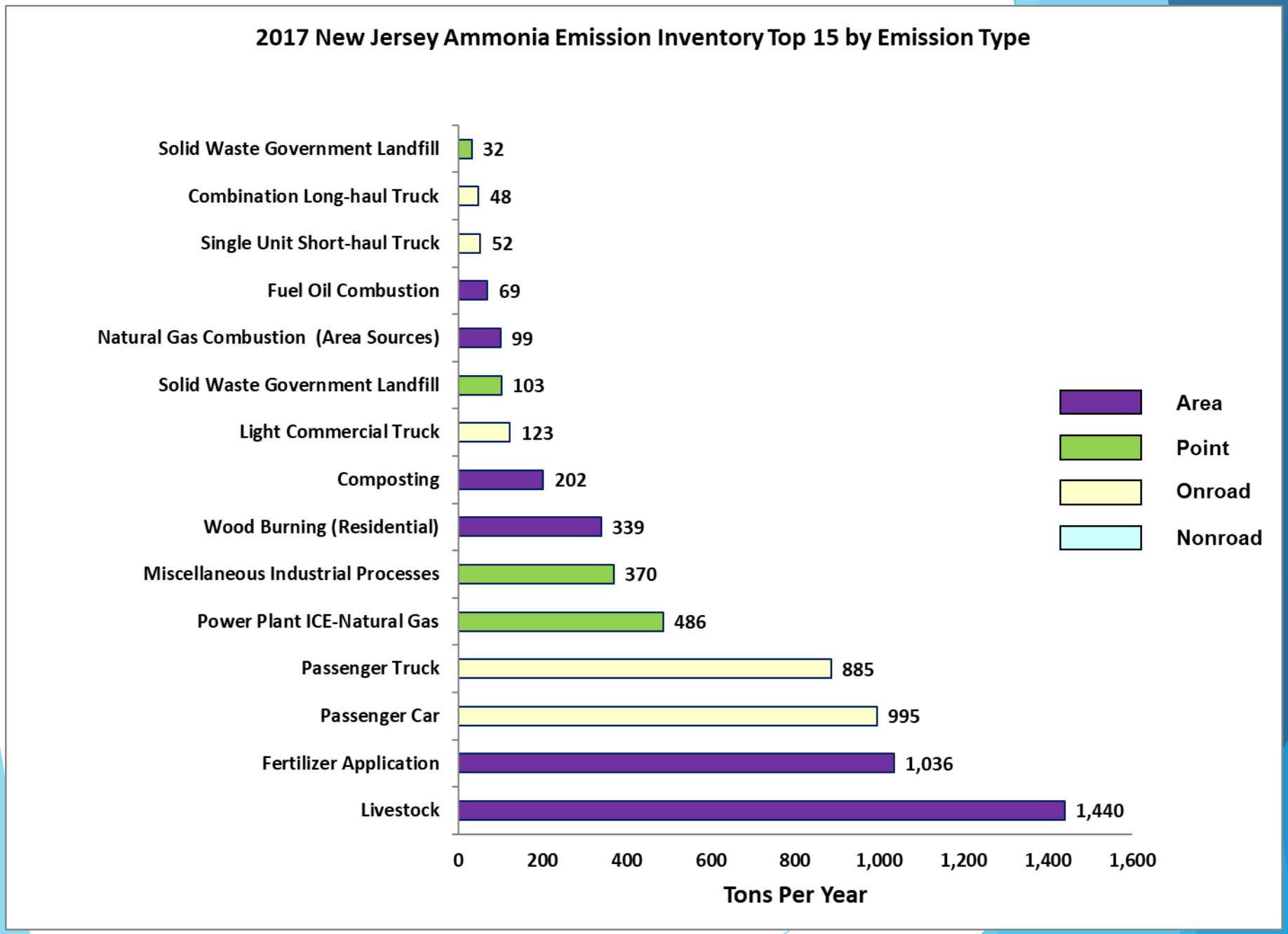


Note: Area Source fugitive dust emissions are post-adjustment.

2017 New Jersey Sulfur Dioxide Emission Inventory Top 15 by Emission Type




2017 New Jersey Carbon Monoxide Emission Inventory Top 15 by Emission Type
Industrial Equipment 4-Stroke
14
Natural Gas Combustion (Area Sources)
15
Industrial Equipment LPG
15
Construction Equipment Diesel
17
Motorcycles
21
Pleasure Craft 2-Stroke
31
Construction and Mining Equipment 4-Stroke
37
Recreational Equipment 4-Stroke
37
Single Unit Short-haul Trucks
48
Lawn and Garden Equipment 2-Stroke
62
Light Commercial Trucks (other use)
69
Commercial Equipment 4-Stroke
182
Passenger Cars
375
Passenger Trucks (primarily personal use)
573
Lawn and Garden Equipment 4-Stroke
626
0
100
200
300
400
500
600
700
Summer Tons Per Day
Area
Point
Onroad
Nonroad


2017 New Jersey Ammonia Emission Inventory Top 15 by Emission Type
Solid Waste Government Landfill
32
Combination Long-haul Truck
48
Single Unit Short-haul Truck
52
Fuel Oil Combustion
69
Natural Gas Combustion (Area Sources)
99
Solid Waste Government Landfill
103
Light Commercial Truck
123
Composting
202
Wood Burning (Residential)
339
Miscellaneous Industrial Processes
370
Power Plant ICE-Natural Gas
486
Passenger Truck
885
Passenger Car
995
Fertilizer Application
1,036
Livestock
1,440
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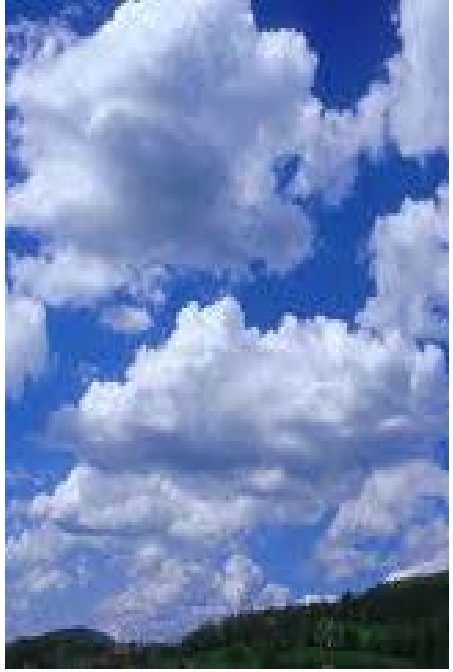
200
400
600
800
1,000
1,200
1,400
1,600
Tons Per Year
Area
Point
Onroad
Nonroad



Thanks!

Questions?

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