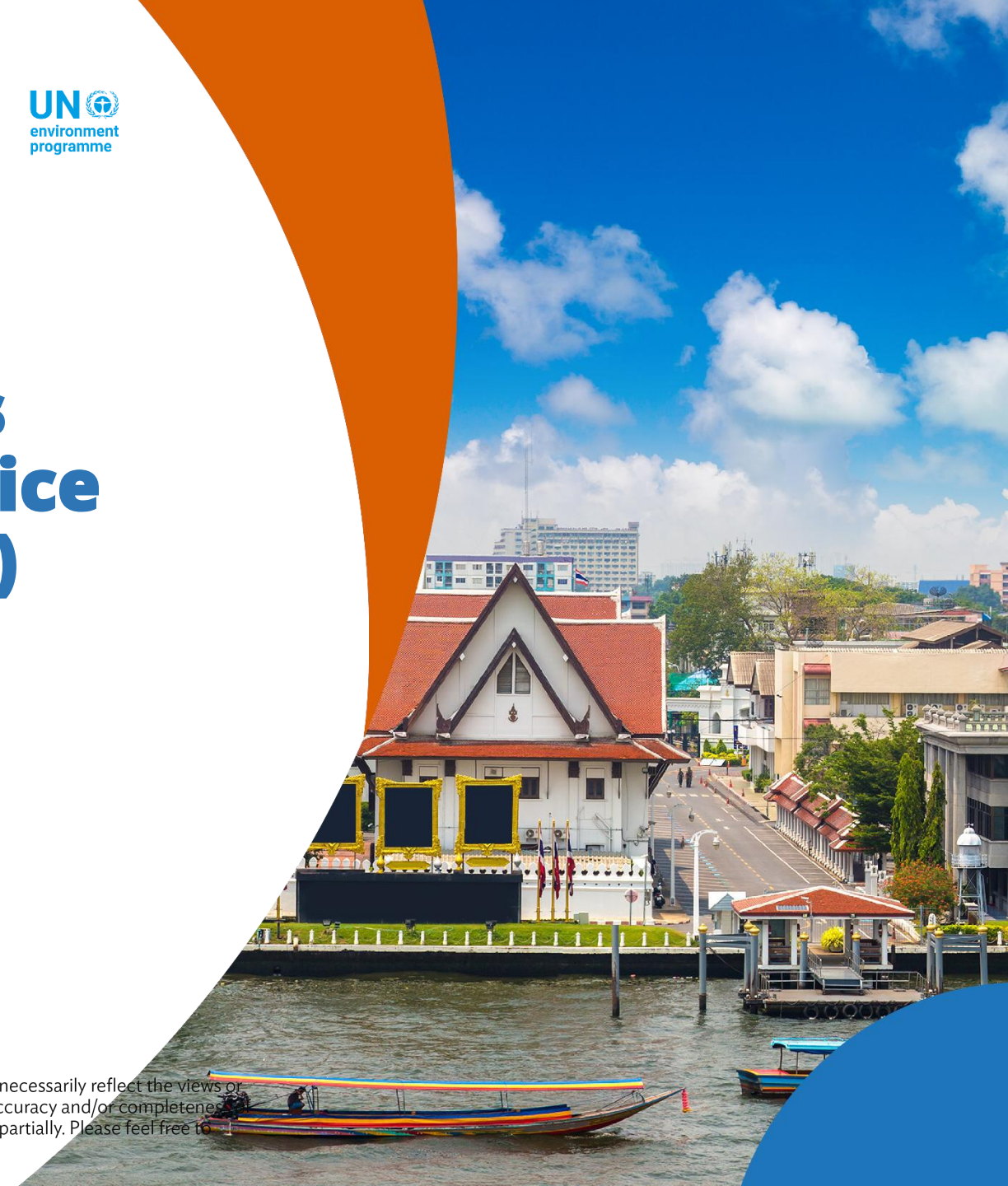
Shanghai's Industrial VOCs Control : A Decade of Practice and Progress (2014 – 2024)

Mengya BU

Shanghai Academy of Environmental Sciences

11 March 2026 | Bangkok, Thailand



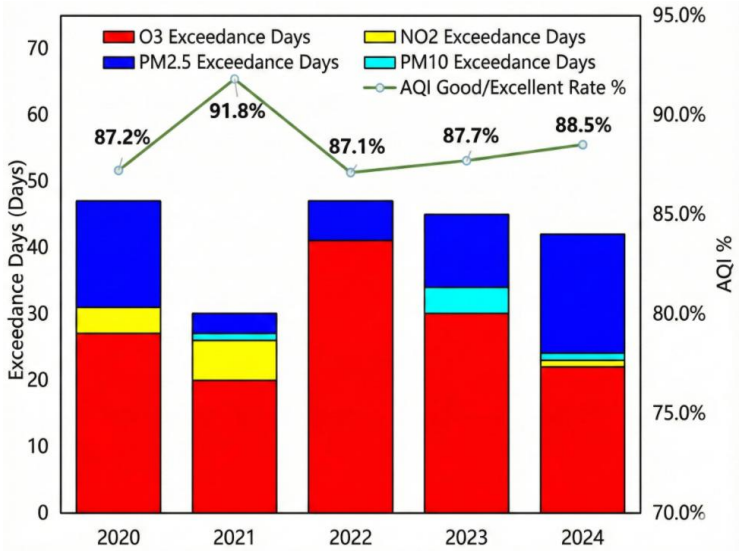
Outline

1 The Challenge & Governance Evolution

2 Key Innovations & Measurable Results

3 Shared Challenges & Future Directions

01 The Challenge & Governance Evolution



$PM_{2.5}$: A Success Story

52 → 28 μg/m³

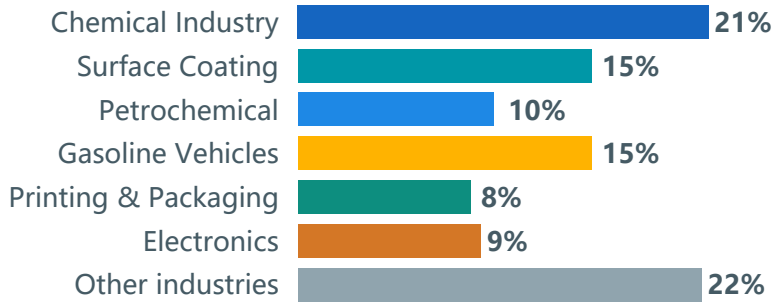
46% decline from 2014 to 2024.
Met national standards since 2020.

O_3 : The Remaining Challenge

66% of pollution days

O_3 was the primary pollutant on 2/3 of exceedance days during 2020~2024.

Where Do Shanghai's VOC Emissions Come From?



🏭 **Industrial sources account for ~70% of total VOC emissions**

→ **This makes strengthening industrial VOC control the top priority for air quality improvement**

Shanghai's Dual Challenge of $PM_{2.5}$ and Ozone

01 The Challenge & Governance Evolution

SAES Science for a Better Environment 科 技 让 环 境 更 美 好

2007
Baseline Building
Included VOCs in the first National Pollution Source Census; established Shanghai's first VOCs emission inventory

2011
Pilot Projects
Selected 4 major enterprises as pilot sites to test LDAR and startup/shutdown/turnaround emission controls

Getting Started

2014
Targeted Action
Identified 150 top-emitting enterprises; required each to develop a tailored **"One-Enterprise, One-Policy"** treatment plan

2015
Scaling Up
Expanded from 150 to 2,000+ enterprises with financial subsidies tied to actual emission reductions

VOCs 1.0

2020
Precision Governance
Launched sector-specific checklists for 6 sectors and 24 industries; shifted from broad coverage to quality-focused control

2024
Deepening Control
Tackling hard-to-abate fugitive emissions through standardized and stringent controls.

VOCs 2.0

Shanghai's VOCs Control Journey

Outline

1 The Challenge & Governance Evolution

2 Key Innovations & Measurable Results

3 Shared Challenges & Future Directions

02 Key Innovations & Measurable Results

SAES Science for a Better Environment 科技让环境更美好

Legal Foundation

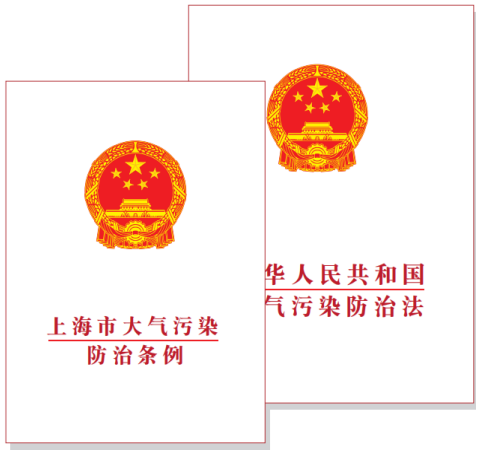
2014 — Shanghai

Enacted PRC's first local regulation requiring full-lifecycle VOCs control (source → process → end-of-pipe). **Pioneered legal penalties for fugitive (unorganized) VOCs emissions** — a first in PRC's environmental legislation.

↓ Adopted by

2015 — National

Key provisions incorporated into PRC's revised Air Pollution Prevention Law

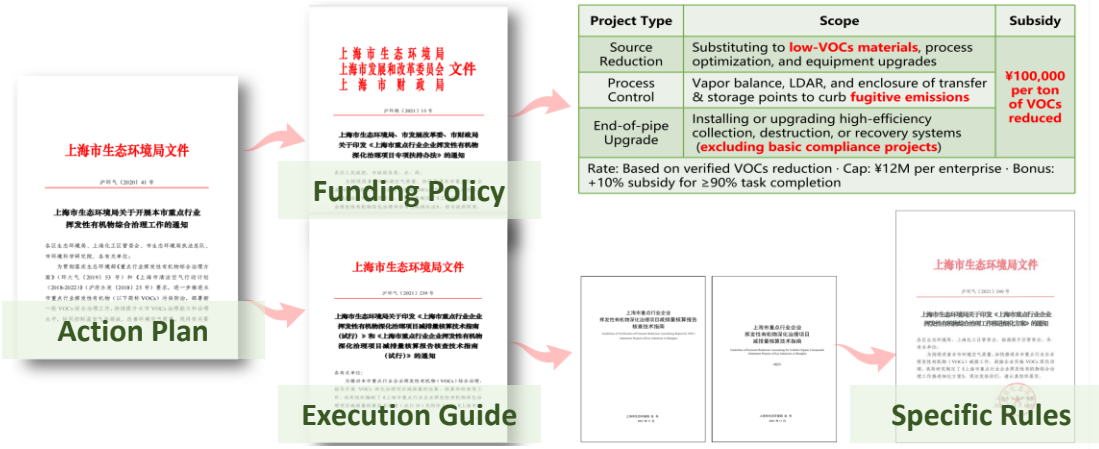


Technical Standards System

Industry-Specific Standards

11 emission standards + **over 10 technical guidelines** covering coating, printing, chemical, shipbuilding, and more.

Comprehensive Policy Mix



Law Leads, Standards Guide

02 Key Innovations & Measurable Results

SAES Science for a Better Environment 科 技 让 环 境 更 美 好

VOCs 1.0 (2014~2018) — One-Enterprise, One-Plan : Five-Step Implementation Process

Plan Drafting → **Expert Review** → **Plan Revision** → **Official Filing** → **Engineering Implementation**

Enterprise drafts, experts review, government files — ensuring quality while keeping enterprises in the driver's seat.

VOCs 2.0 (2020–2024) — One-Sector, One-Checklist : Menu-style Compliance Roadmap

Compliance Level	Source	Process	End-of-pipe
Required	Mandatory VOCs limits	Enclosed operation & LDAR	Compliant treatment
Recommended	Advanced/Green processes	Low/Zero-leakage equipment	High-efficiency systems
Prohibited	——	Open-air spraying & operations	Substandard facilities

6 Major Domains • 24 Sub-Sectors

- Petrochemical
- Chemical
- Coating
- Printing
- Oil Storage
- Industrial Parks

Targeted Policies, Tailored Solutions

02 Key Innovations & Measurable Results

SAES Science for a Better Environment 科技让环境更美好

Shanghai Municipal Bureau of Ecology and Environment

Role: Lead coordinator

Overall planning, policy formulation, unified oversight and enforcement

District-Level Bureau of Ecology and Environment

Role: On-ground implementation

Policy transmission, technical guidance, and day-to-day enterprise monitoring within each district

Shanghai Municipal Development & Reform Commission

Role: Industry alignment

Industrial policy integration; incorporating VOC requirements into sector development plans

Regulated Enterprises

Role: Primary responsible party

Develop and implement facility-specific VOC treatment plans; ensure continuous compliance

Shanghai Municipal Finance Bureau

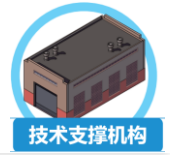
Role: Funding guarantee

Ensure dedicated funding and budget allocation for VOCs treatment subsidies and special projects

Technical Support Institutions (e.g. SAES)

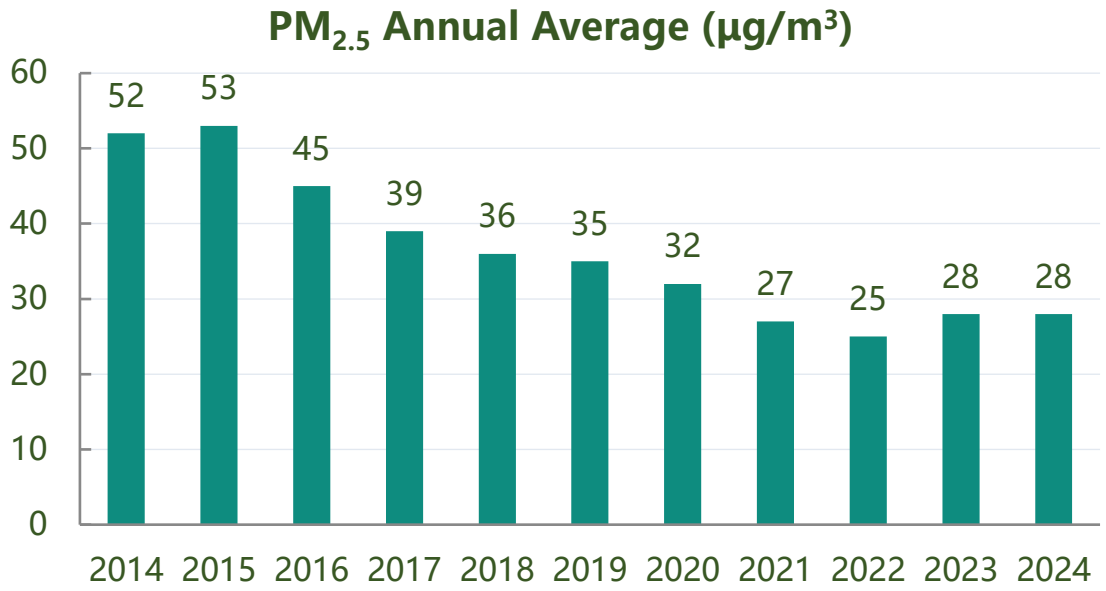
Role: Full-cycle technical backbone

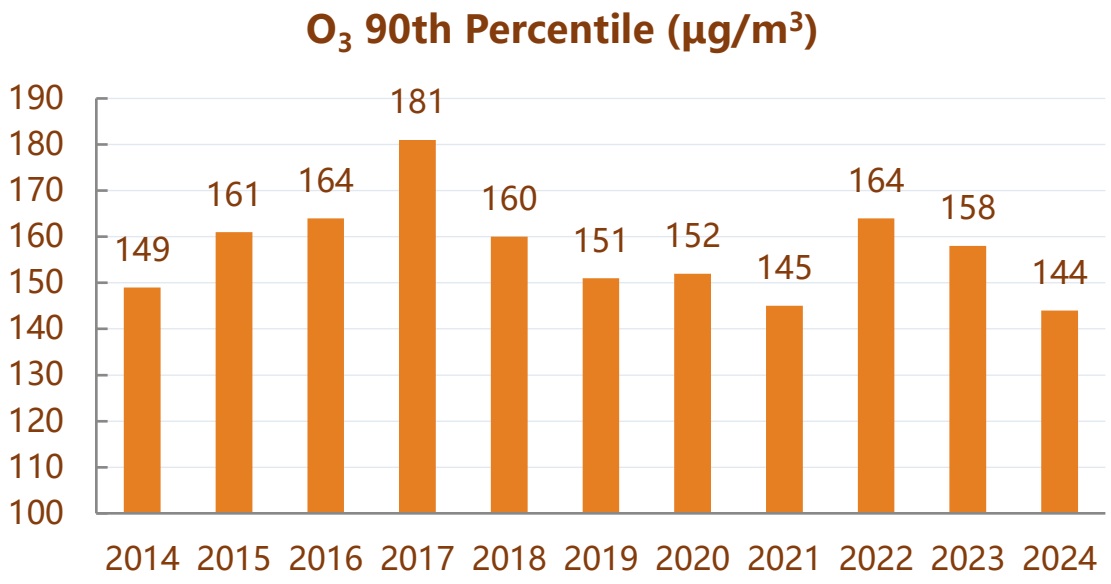
Policy & standards research, enterprise technical assistance, treatment effectiveness evaluation



Aligned Roles, Shared Mission

02 Key Innovations & Measurable Results





- **$PM_{2.5}$ down 46% since 2014.** First met all national air quality standards in 2020, staying below the national standard for 5 consecutive years.
- **O_3 seesaw effect overcome.** Early $PM_{2.5}$/NO_x reductions inevitably pushed O_3 up (peaking at 181 μg/m³ in 2017). Through sustained VOCs control, Shanghai reversed this trend and brought O_3 back below its 2014 baseline — even as O_3 continued rising across most Chinese cities.

Measurable Results

Outline

1 The Challenge & Governance Evolution

2 Key Innovations & Measurable Results

3 Shared Challenges & Future Directions

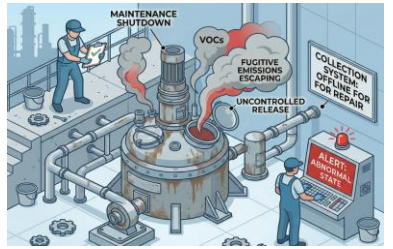
03 Shared Challenges & Future Directions

■ Source Substitution Hurdles

- Low-VOCs materials are available but adoption is limited by cost and process compatibility — especially in shipbuilding, auto parts, and furniture.

■ Fugitive and Abnormal Emissions

- Emissions during startup, shutdown, maintenance, and equipment leaks remain the weakest link — difficult to monitor and standardize.



■ End-of-Pipe Facility Performance Gaps

- Treatment facilities are widely installed, but stable operation remains a challenge — calling for low-cost, full-process monitoring solutions.

Common Problems, Common Opportunities

03 Shared Challenges & Future Directions

SAES Science for a Better Environment 科 技 让 环 境 更 美 好

Shanghai will continue advancing industrial VOCs control along three directions:

Direction 1—— Synergy of Pollution and Carbon Reduction

- Integrate VOCs control with greenhouse gas reduction strategies to achieve co-benefits
- Promote low-VOCs raw materials, cleaner production and low-carbon treatment technologies

Direction 2—— Tackling Hard-to-Abate Emissions

- Strengthen regulation of emissions during startup, shutdown and maintenance operations
- Improve treatment facility reliability through cost-effective full-process monitoring tools

Direction 3—— Smart Regulation and Tech Empowerment

- Deploy mobile optical remote sensing platforms (SOF, DOAS, FTIR) for area-source measurement
- Build comprehensive online monitoring systems enabling real-time performance evaluation

Deeper Reduction, Smarter Governance

BAQ 2026
BETTER AIR QUALITY CONFERENCE
11-13 MAR • BANGKOK

Thank you for Listening!