Regional Approaches to Reduce Pollution in Transboundary Airsheds: Inception Workshop

13:00-16:00am (BKK Time), 25 June 2024

United Nations Conference Centre and via Video Conferencing

Supported by the US Department of State

25 June 2024

ESCAP
Economic and Social Commission for Asia and the Pacific

Draft Programme

Time	Agenda
13:00-13:05	Opening , UN ESCAP
13:05-13:25	High-Level Segment
13:25-13:30	Virtual Group Photo
13:30-13:40	Project Background and Path Forward
13:40-14:00	Methodology for Airshed Analysis Dr. Sarath Guttikunda
National Segment	
30 Mins	Bhutan Scene Setting (5 Min: ESCAP) National Perspective (15 Min: Ministry/City) Q&A (10 min)
30 Mins	Cambodia Scene Setting (5 Min: ESCAP) National Perspective (15 Min: Ministry/City) Q&A (10 min)
30 Mins	Laos Scene Setting (5 Min: ESCAP) National Perspective (15 Min: Ministry/City) Q&A (10 min)
International Segment	
20 Mins	Discussion Session on Cooperation Priorities • Data • Actions • Communities of Practice
Closing and Summation	
10 Minutes	Closing Remarks and Next Steps

Curt Garrigan

Chief, Sustainable Urbanization and Development Section, Environment and Development Division

UNESCAP



Paul Neville

Deputy Permanent Representative to UNESCAP, US State Department



Virtual Group Photo

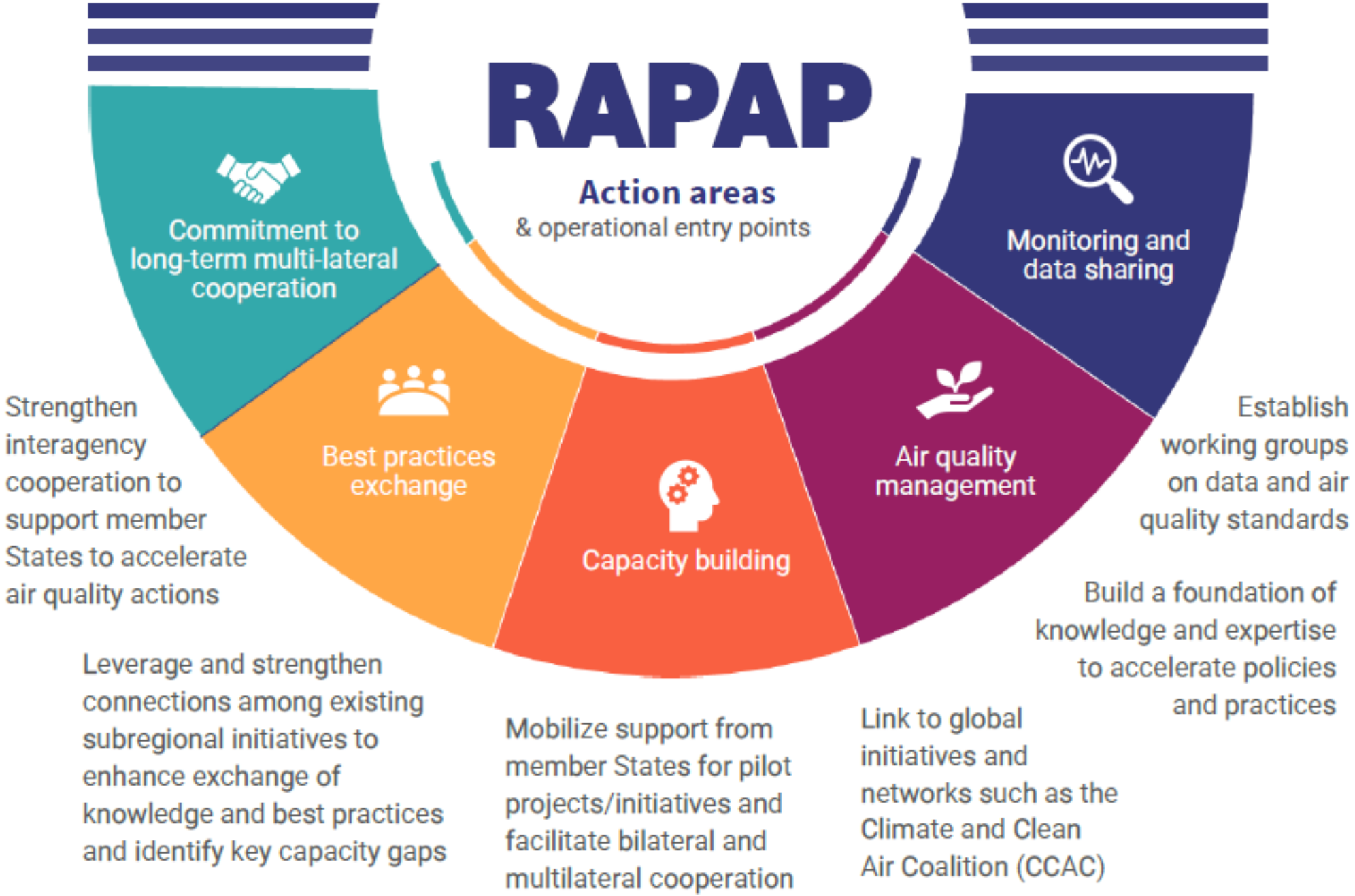
Matthew Perkins

Economic Affairs Officer
UN ESCAP



Project Background

Path Forward

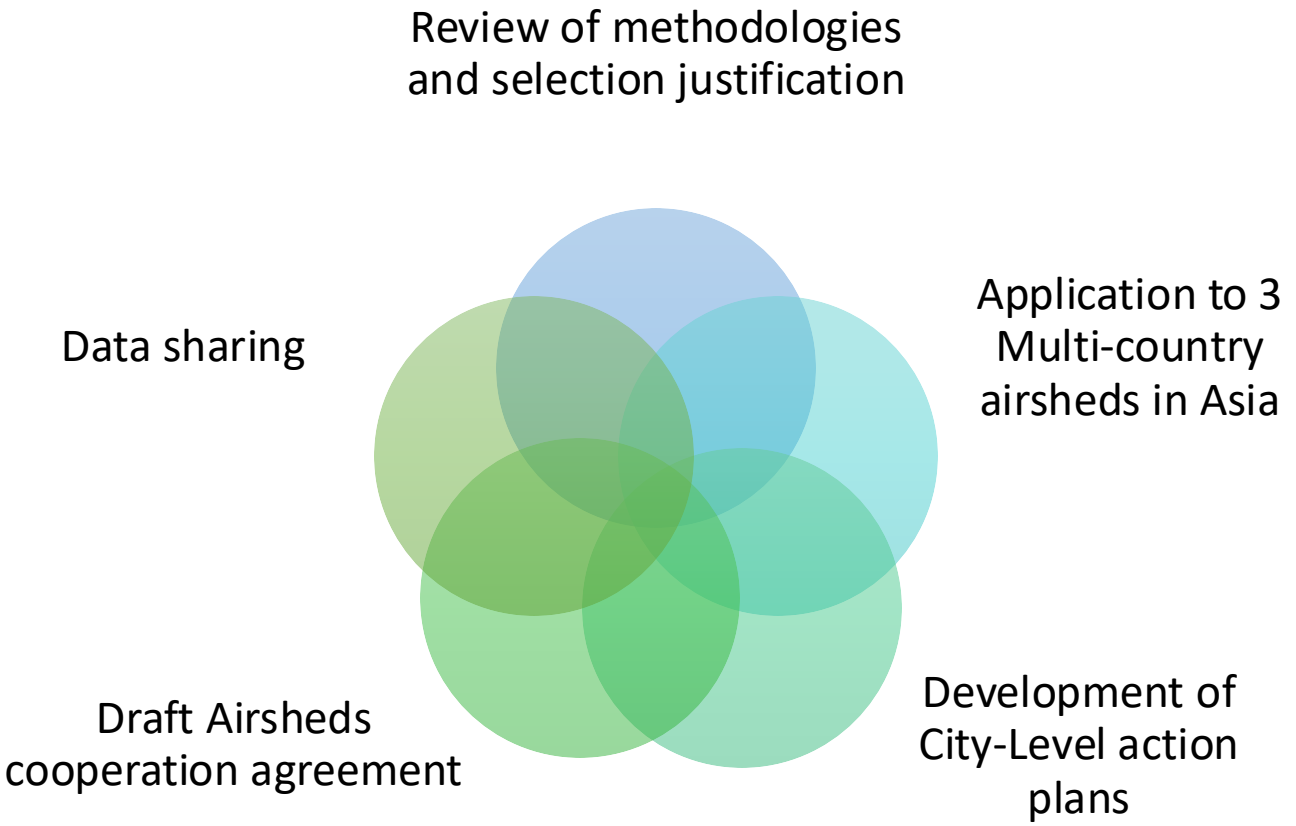

RAPAP
Action areas
& operational entry points
Commitment to long-term multi-lateral cooperation
Best practices exchange
Capacity building
Air quality management
Monitoring and data sharing
Strengthen interagency cooperation to support member States to accelerate air quality actions
Leverage and strengthen connections among existing subregional initiatives to enhance exchange of knowledge and best practices and identify key capacity gaps
Mobilize support from member States for pilot projects/initiatives and facilitate bilateral and multilateral cooperation
Link to global initiatives and networks such as the Climate and Clean Air Coalition (CCAC)
Build a foundation of knowledge and expertise to accelerate policies and practices
Establish working groups on data and air quality standards

Project Goals

The project will focus on the improvement air quality in multi-country airsheds.

The engagement of stakeholders at all levels of jurisdiction will enhance regional cooperation and strengthen collaboration among cities/subnational authorities and national governments.

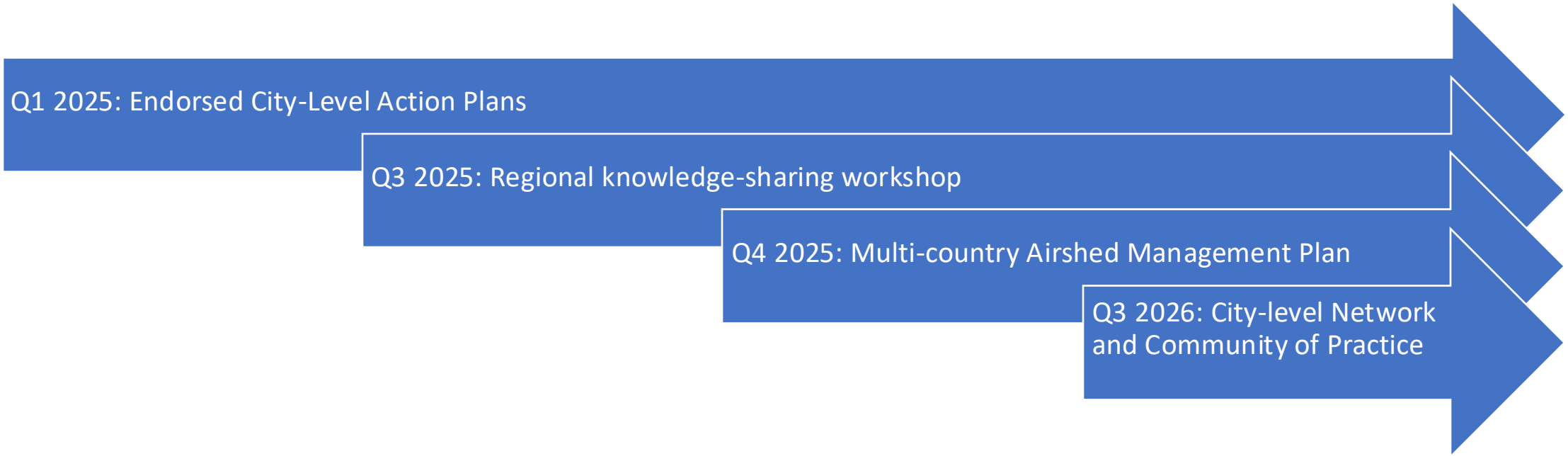
Project Activities 2024-2026 and EANET Alignment



Project Timeline: Support Science-Based Policy



Project Timeline: Establish Networks



Partnerships - Second ASEAN Haze Free Roadmap (2023-2030)

Strategy 2: Developing and implementing subregional strategies

Strategy 3: Sustainable management of agricultural land and forests to prevent large scale land and/or forest fires.

Strategy 5: Securing adequate resources from multi-stakeholders for transboundary haze prevention.



Strategy 6: Strengthening relevant national policies, laws, regulations, and their implementation (including follow-up and review/enforcement)

Strategy 7: Enhancing cross-sectoral and multilevel cooperation to protect the global environment

Stakeholder Mapping



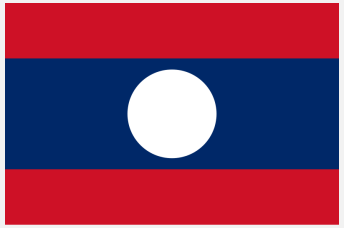
- ICIMOD (International Centre for Integrated Mountain Development)
- UNDP is collaborating with Bhutan on a project called "Bhutan Sustainable Low-emission Urban Transport Systems" from 2019 through 2023
- Regional Science Policy Dialogue on Air Quality Management in the Indo-Gangetic Plain and Himalayan Foothills (IGP-HF)

Stakeholder Mapping



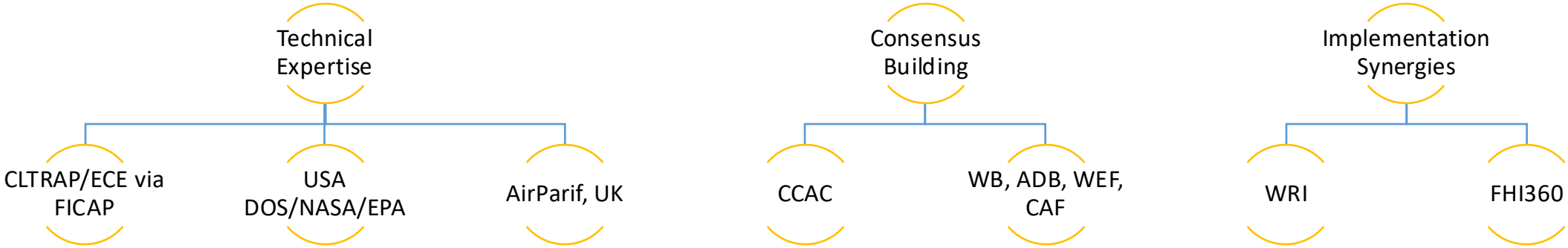
- The Air Quality in Southeast Asia Project – AQSEA (USA, RTI)
- Thailand Environment Institute, TAI Cambodia Coalition works on improving environmental governance, including air pollution management, through advocacy and policy engagement
- DAQNM is leading a project called "Strengthening Air and Climate Pollution Management in Cambodia“
- EANET is actively involved in air quality management in Cambodia
- JICA

Stakeholder Mapping



- KOICA (Korea International Cooperation Agency) and Global Green Growth Institute (GGGI) are funding a four-year project to improve wastewater and solid waste management in Vientiane Capital and Pakse city, which indirectly contributes to better air quality
- UNDP Accelerator Lab in Lao PDR collaborates with its counterpart in Thailand on the "Clean Air Without Border" initiative
- EANET is actively involved in air quality management in Lao PDR

Partnership Proposals



Next Steps



Peer-Review Draft Studies



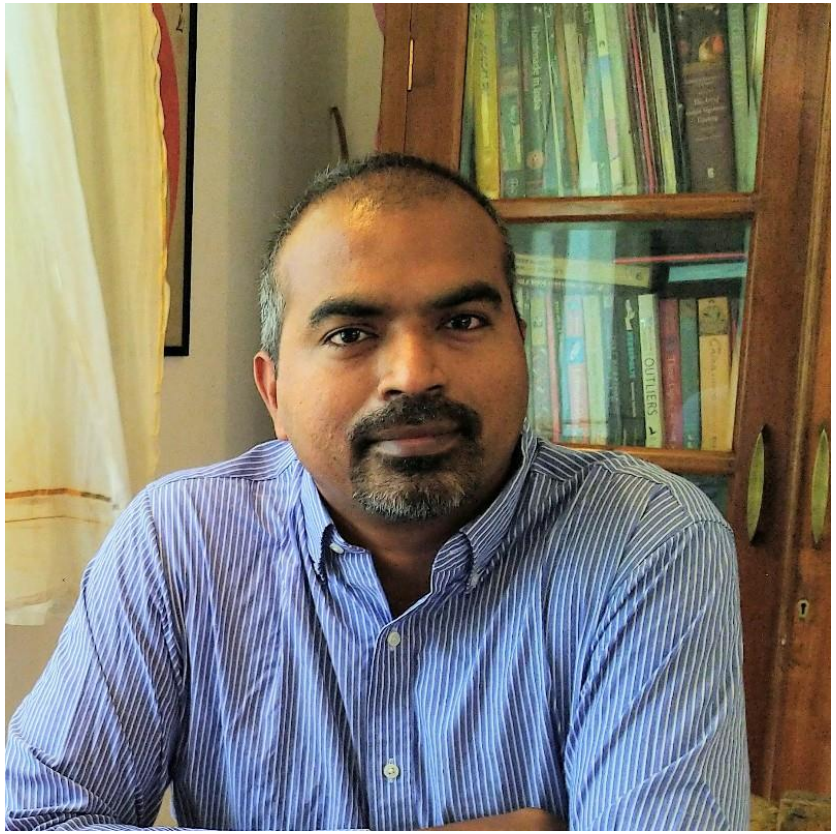
Coordinate with Cities and local stakeholders



Letter of Agreement and Transfer of Funds

Sarath K. Guttikunda

Founder & Director
Urban Emissions, India



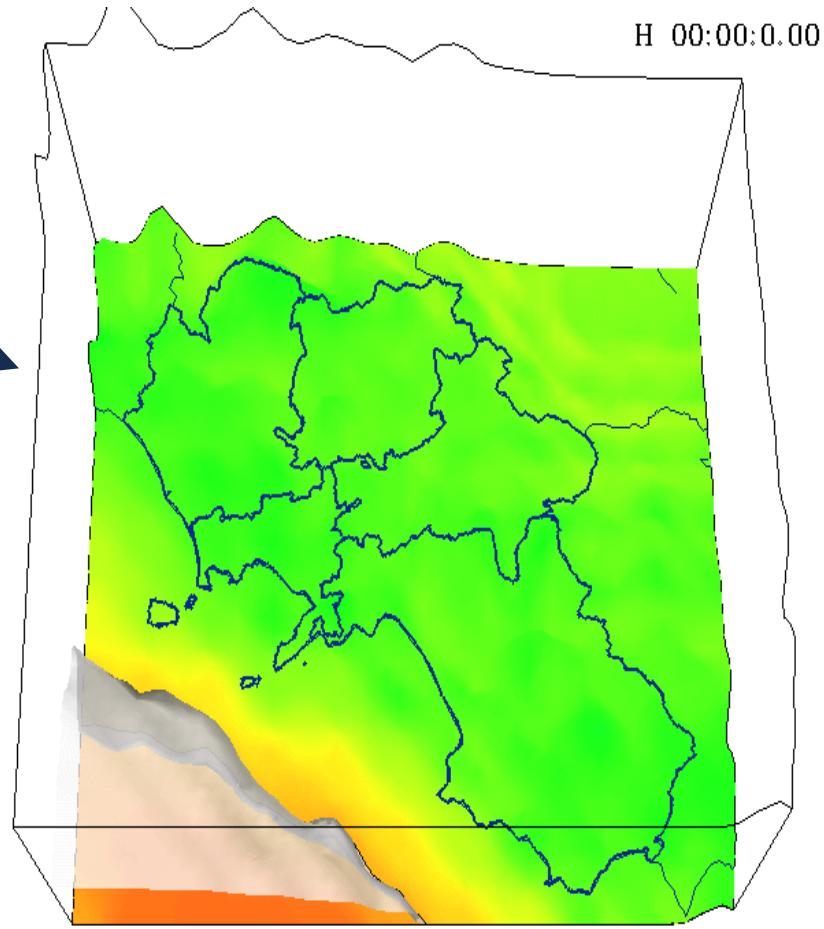
Designating Airsheds for AQM: Concepts and Examples

Dr Sarath Guttikunda

URBAN emissions .info

Why we need airsheds?

What's in the imaginary box?



Why we need airsheds?

1. We want to know the trends (ranking)
2. Contribution of sectors
3. Contributions to each other
4. Regional coordination

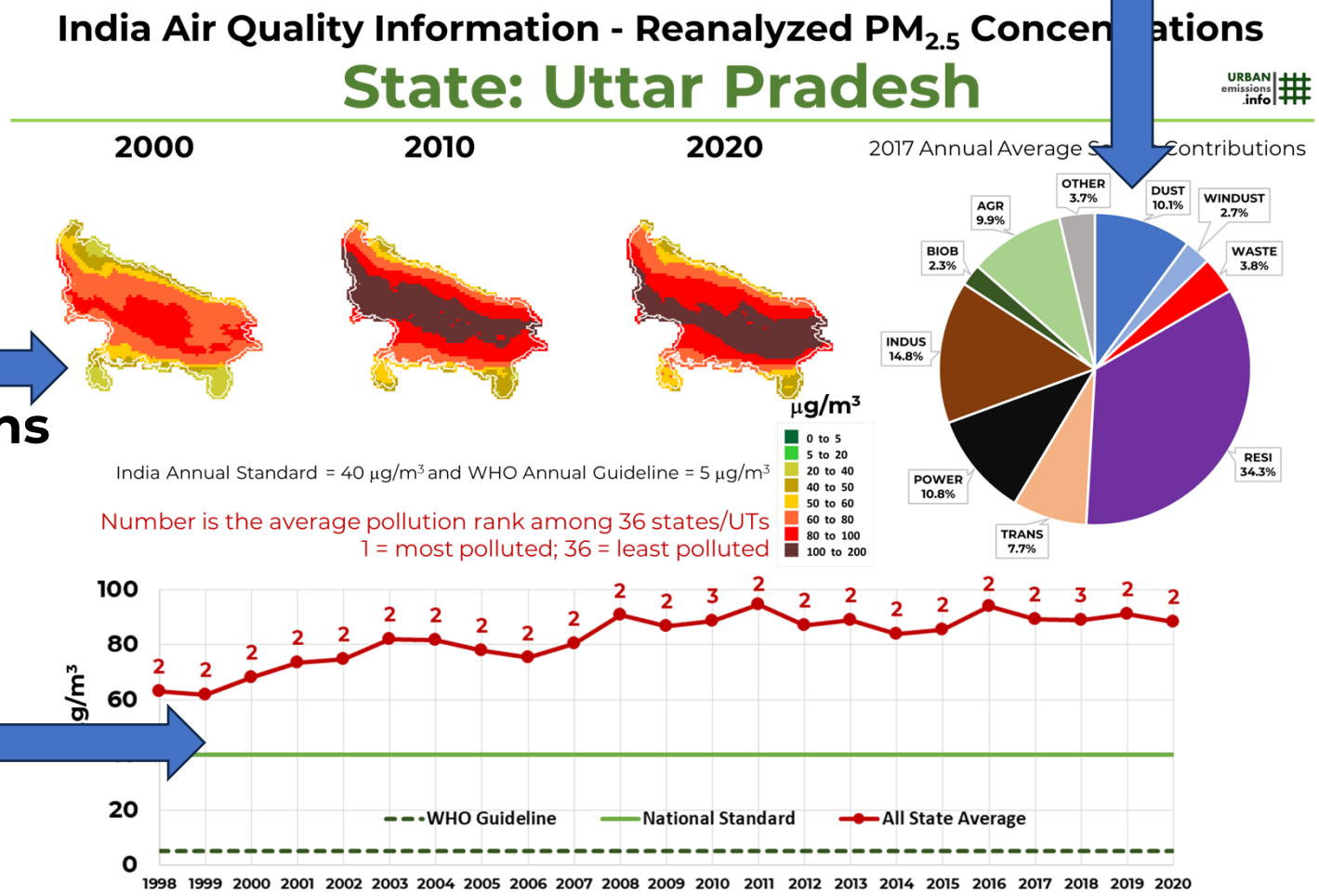
Where we use the airsheds?

1. Modelling

Spatial contributions

Trends

Sectoral contributions

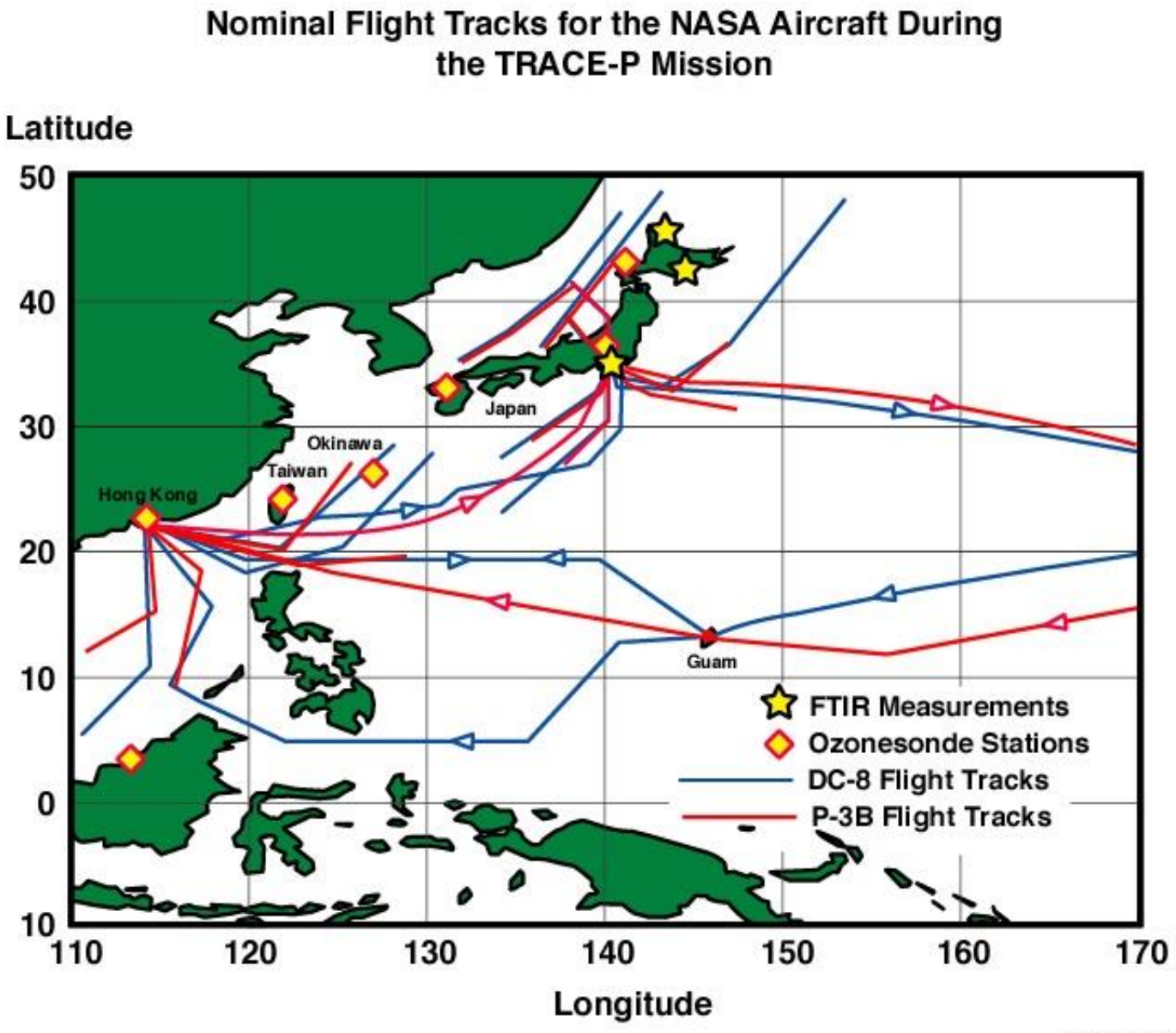


There is no set definition for “airshed”

… you are working in an area,
that’s your airshed

… pretty much, depends on
“who is asking”

Designating Airsheds – Who is asking?



What are we looking for?

.. a common base

.. for urban and regional coordination, collaboration, integration

.. of knowledge and efforts

Designating Airsheds – What are we looking for?

Urban

$PM_{2.5}$ and PM_{10}

Regional

SO_2, NO_2, CO, and Ozone

Multi-pollutant plans

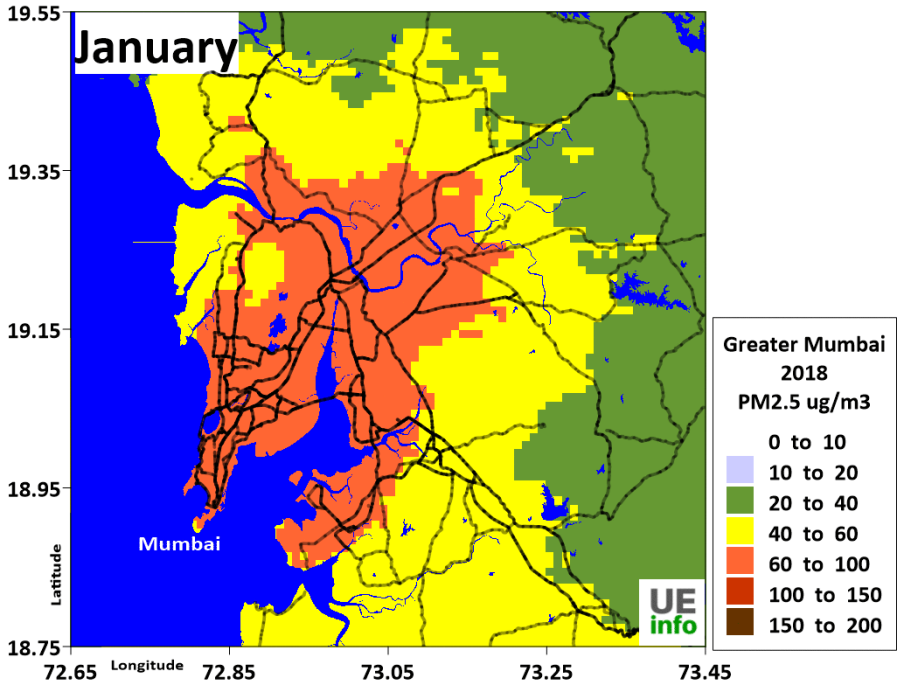
How to define the box (airshed)?

Designating Airsheds in India

Mathematical Modelling	Governance Management
Urban	Urban/Regional

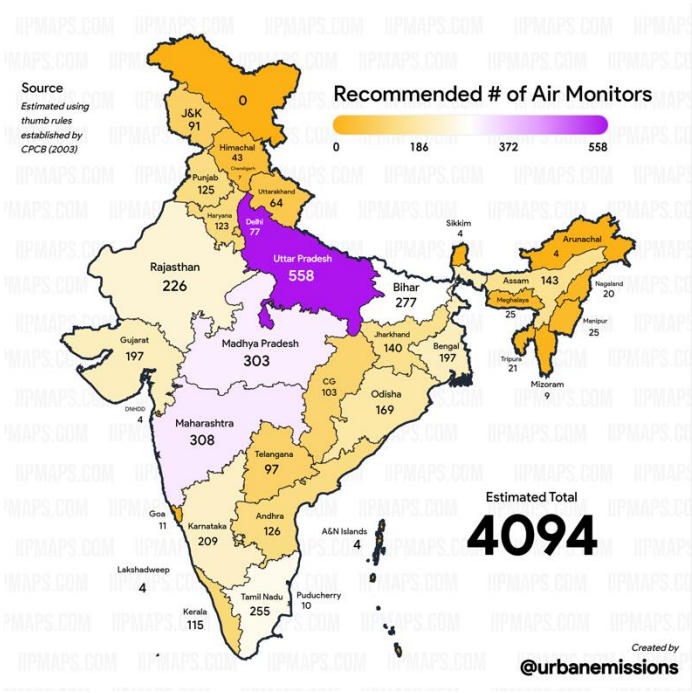
Governance

Urban



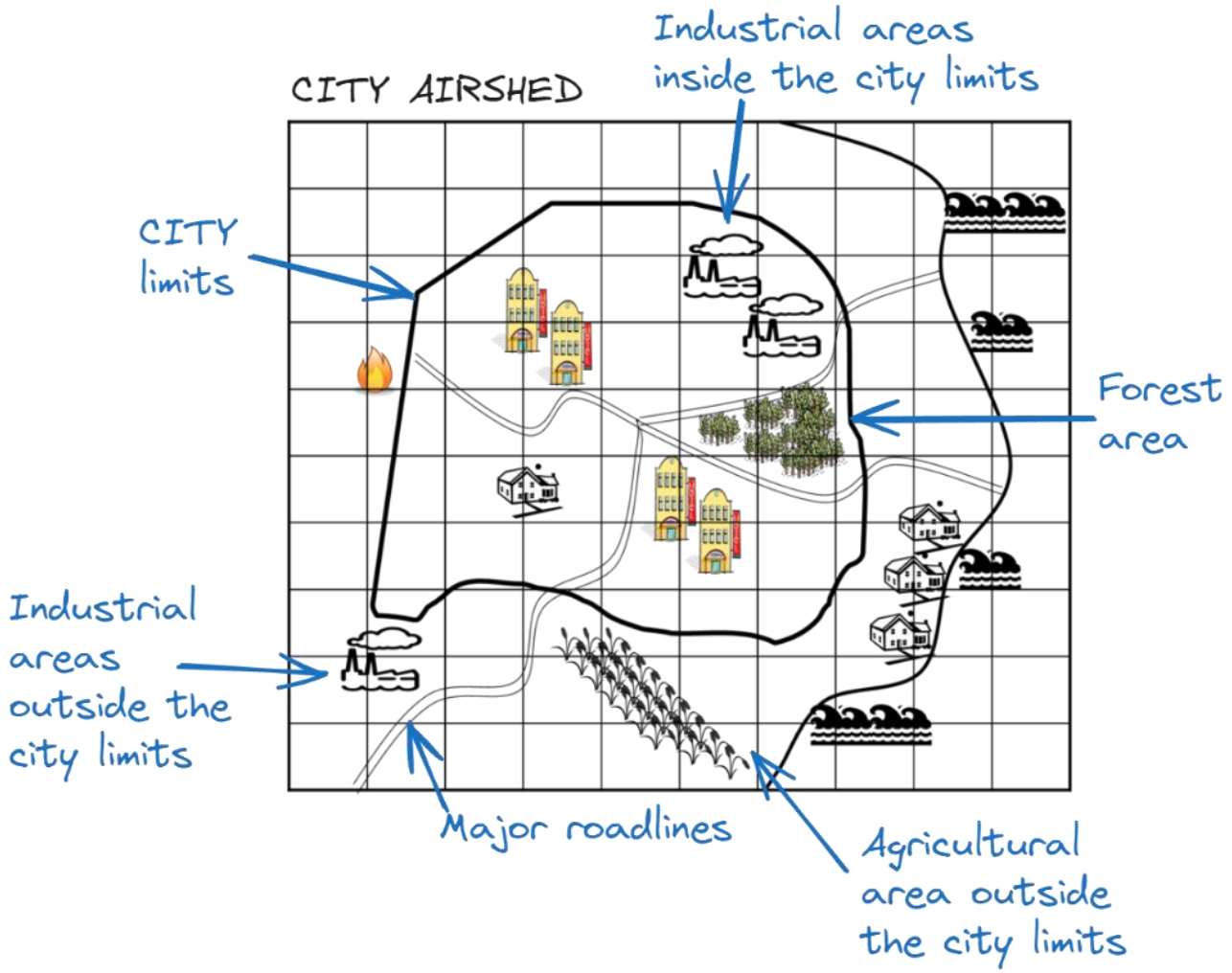
Urban local bodies, Municipalities, and state bodies

Regional



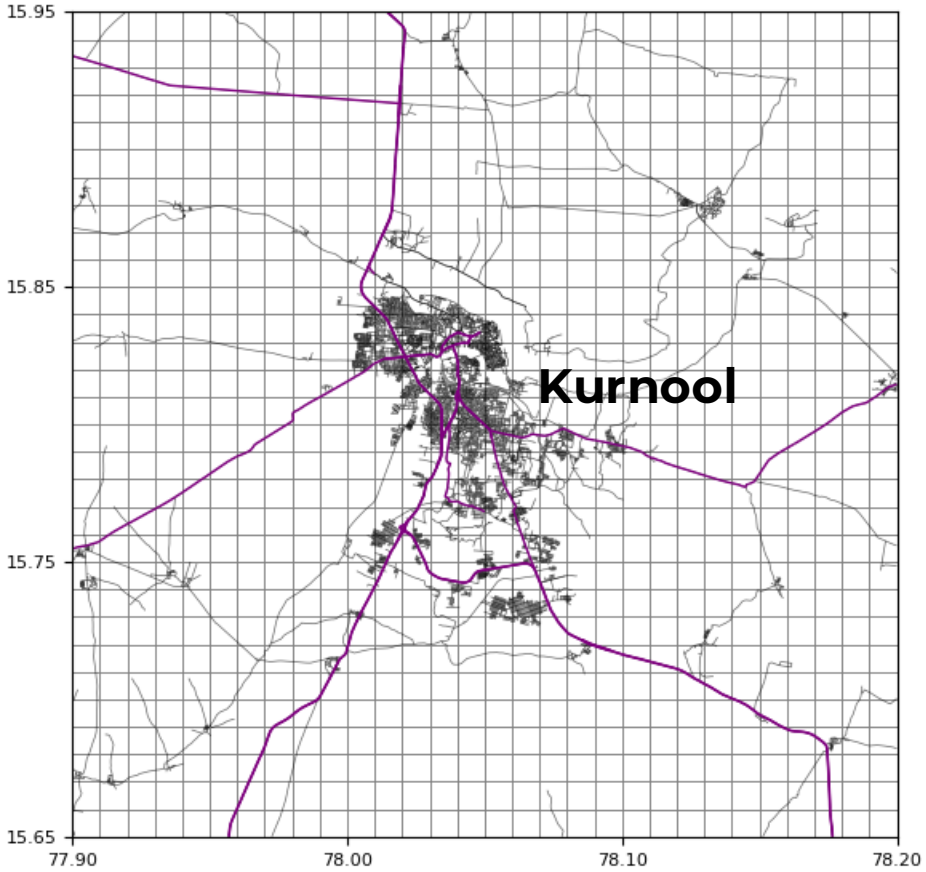
State and Central Ministries

Mathematical (Urban)

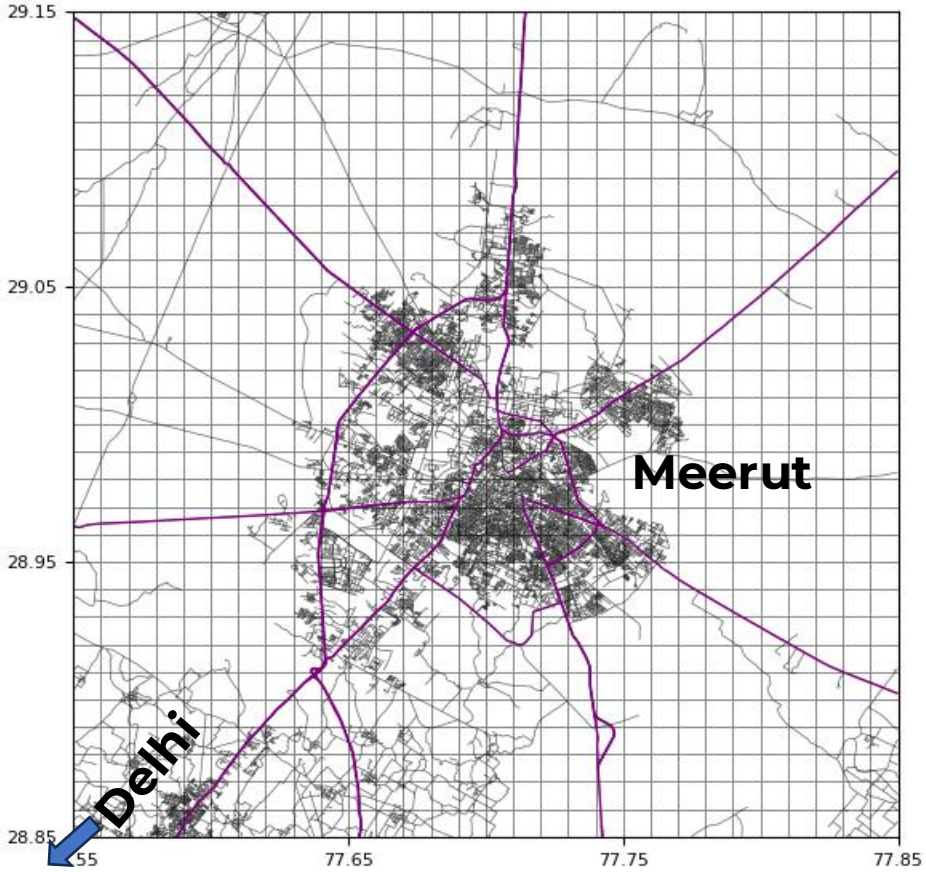


Mathematical (Urban)

Kurnool

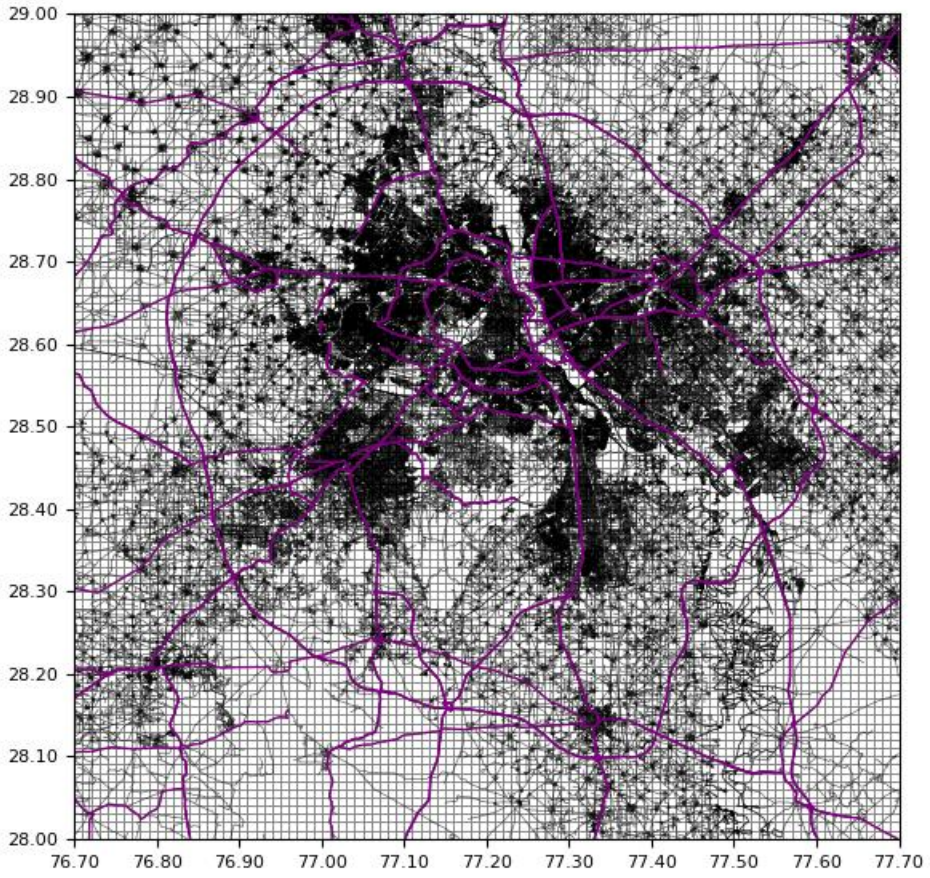


Meerut

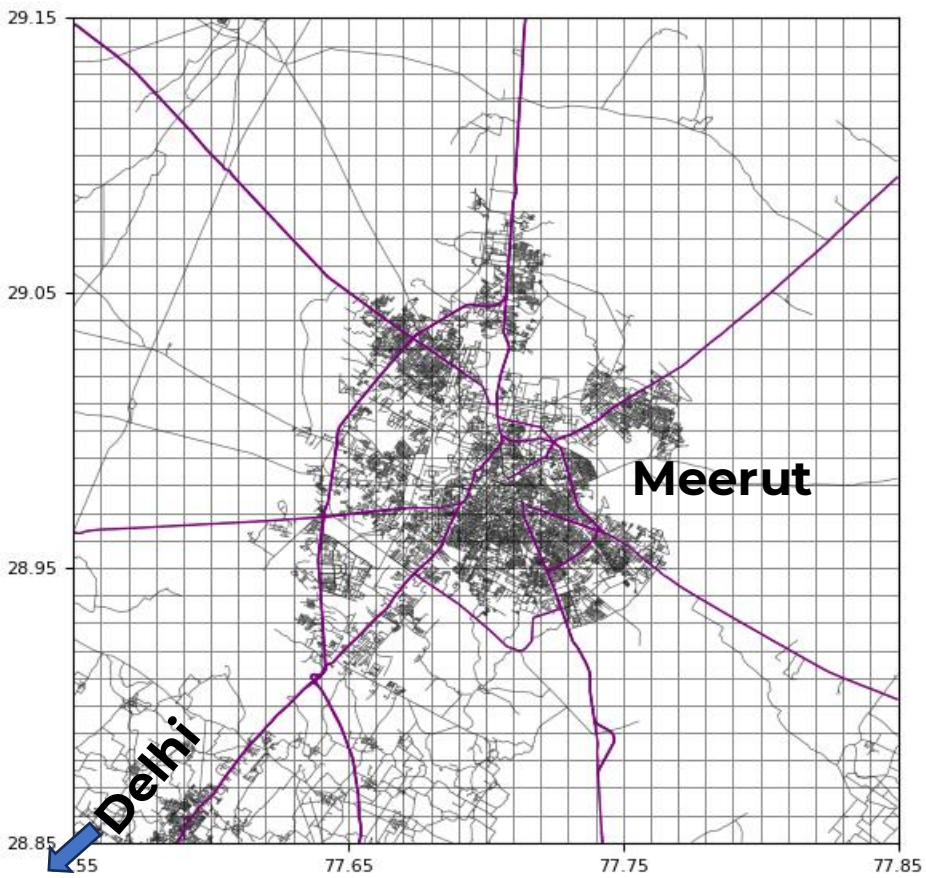


Mathematical (Urban)

Delhi

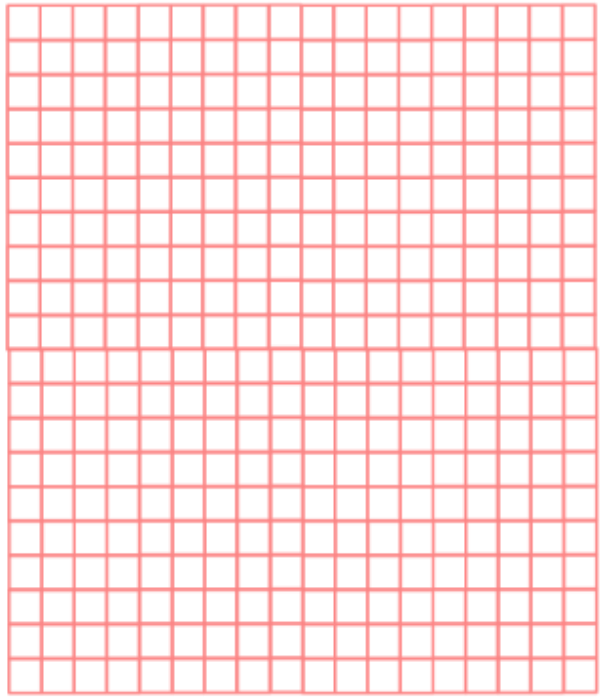


Meerut

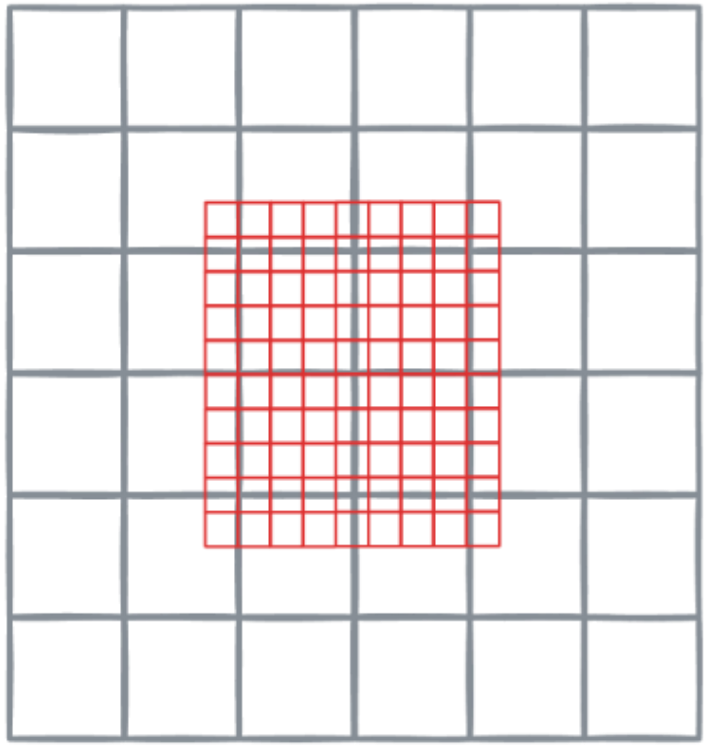


Mathematical + Governance (Semi-Regional)

Full domain example
100x100 grids

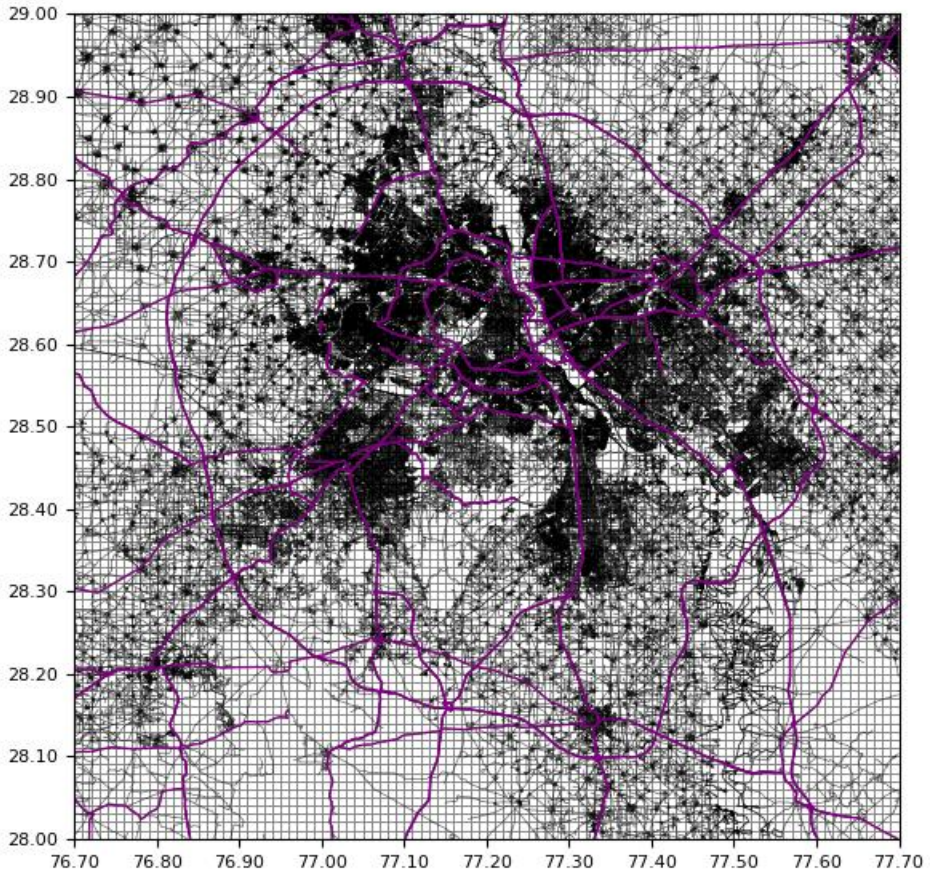


Nested domain example
40x40 grids for full + 50x50 grids for core

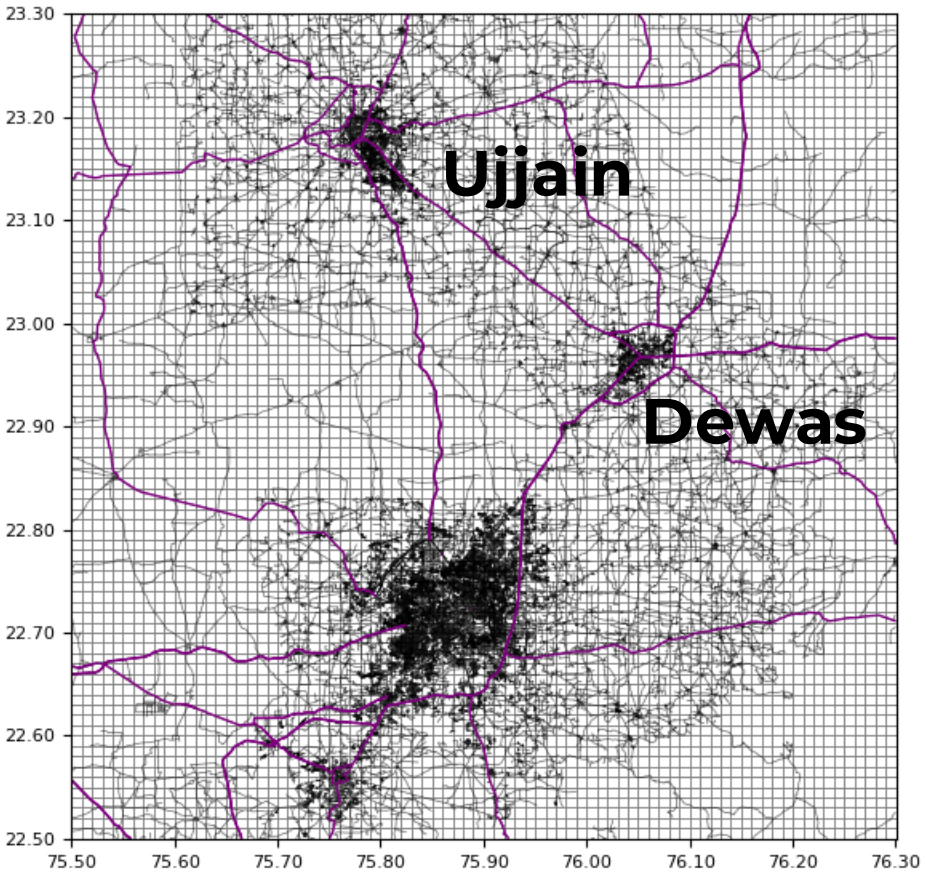


Mathematical (Urban)

Delhi



Indore



Designated Airsheds for NCAP cities

https://urbanemissions.info/india-air-quality/india-ncap-city-airsheds

Updated: March, 2023



131 NCAP non-attainment cities are grouped into 104 airsheds. Of these airsheds, 73 contain only one city; 18 contain two cities, and nine contain three cities. Four airsheds – Delhi, Mumbai, Indore, and Chandigarh contain 10, 8, 5, and 5 cities respectively. An additional 33 cities, not on the NCAP list are also part of these airsheds.

In the table below, the designated airsheds are presented in a grid-format as a Google Earth enabled KML file and as a CSV file with data on grid no. (starting with the southwest corner going left to right and bottom to top), SW and NE corners and mid-points of each grid, and grid area in sq.km. For each of the designated airsheds, an infographic (click on image) containing airshed extent with roads and some useful details is also available.

Download full resolution animation of all the infographics on this page here (or click on the icon)

Visualize the airshed grid extent on OpenStreetMaps (here). Allow some time to load the grid files.

Journal Article on airshed designation process and monitoring needs (2023): here
Journal article with review of NCAP action plans (2020): here

Back to NCAP data repository.

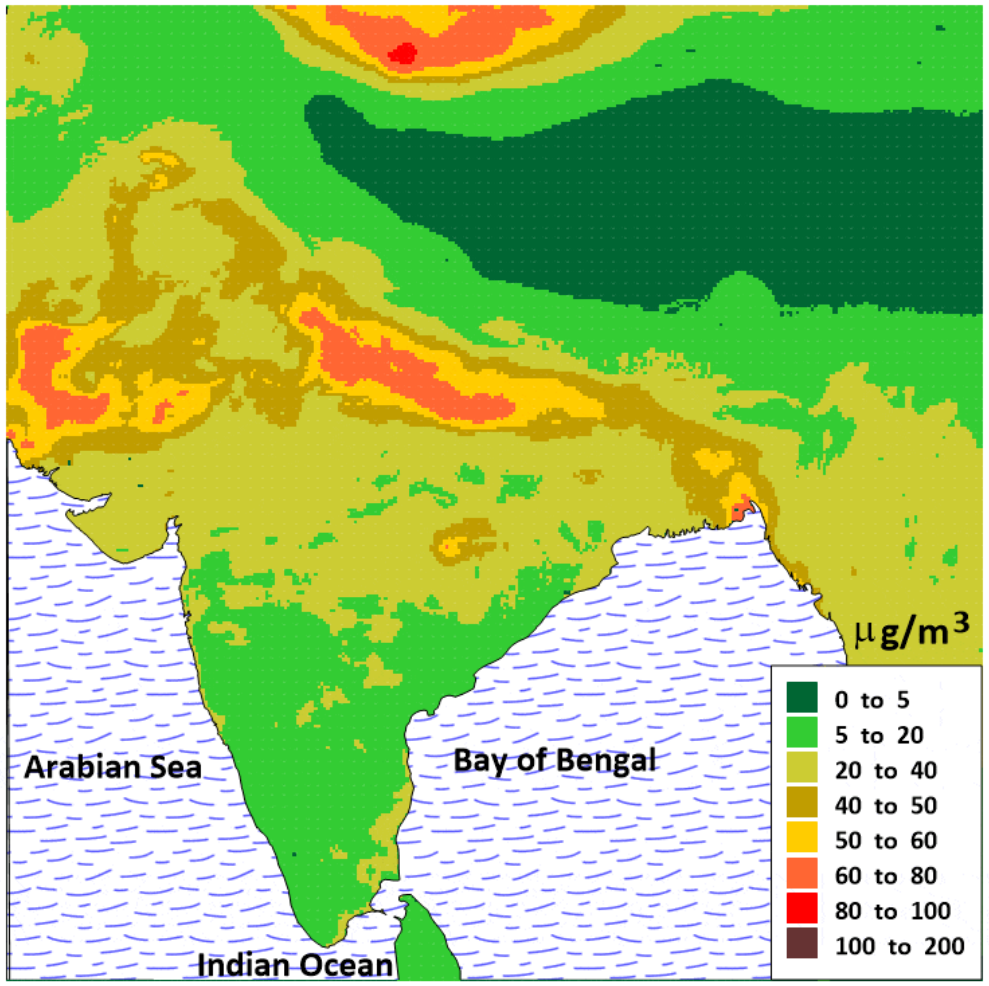
Designated Airshed, Sizes,, KML Files and Infographics

Search:

S.No.	State	Airshed	Airshed Size (0.01 deg grids)	Google Earth KML file	Excel File with Details	Infographic
1	Andhra Pradesh	Anantapur	30 x 30	KML	CSV	IMAGE
2	Andhra Pradesh	Chitoor	30 x 30	KML	CSV	IMAGE

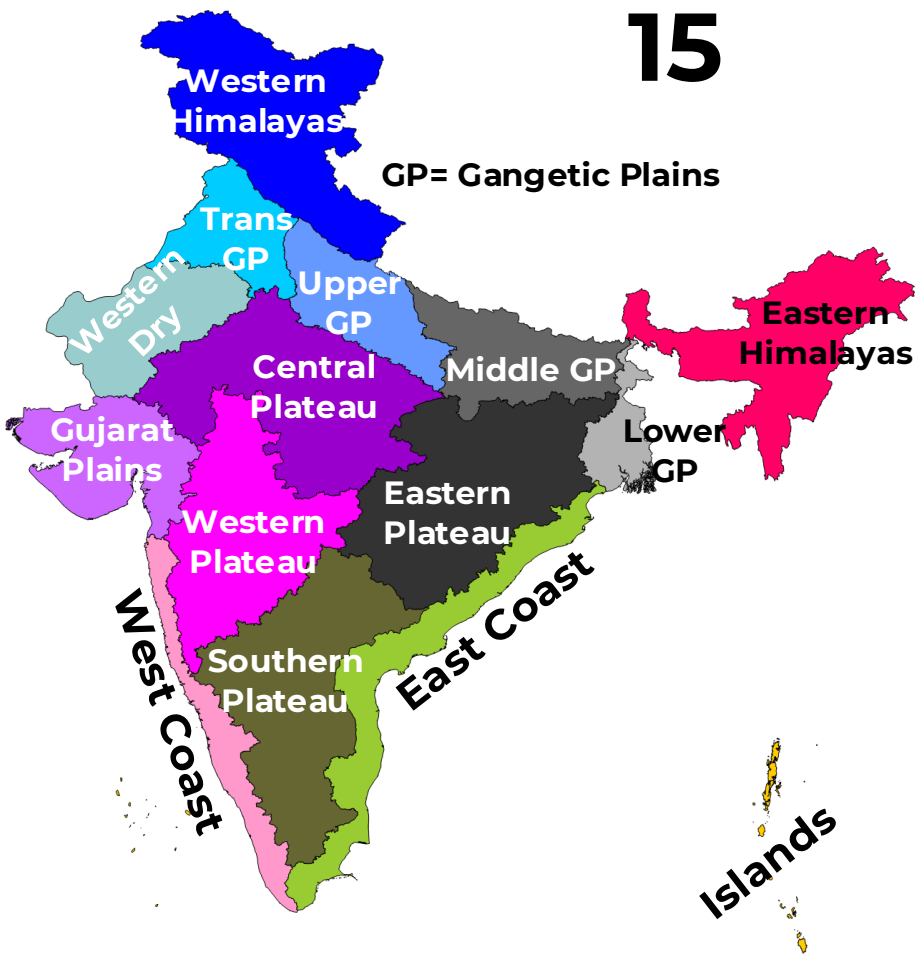
Designating Airsheds in India (Regional)

What's in the box?



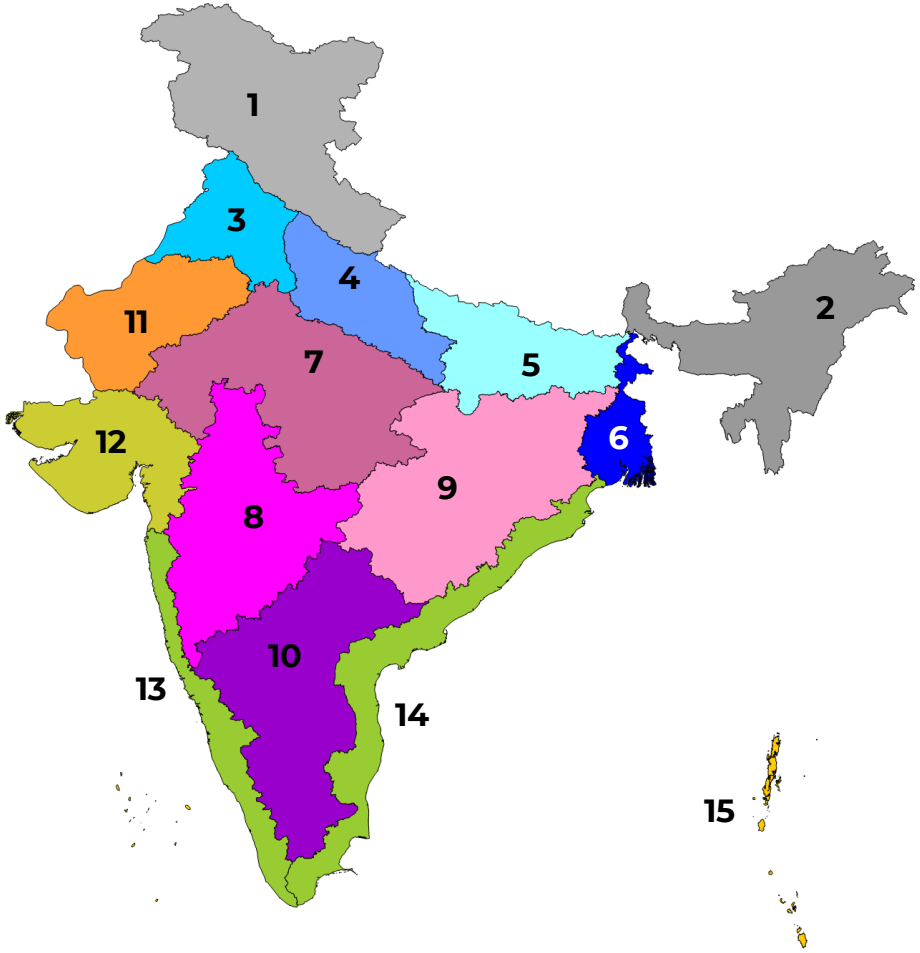
Reanalyzed $PM_{2.5}$ for Year 1998

Designating Airsheds in India (Regional)



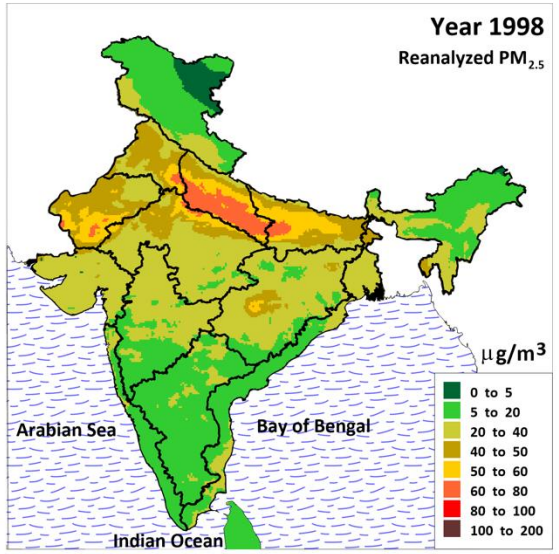
- States (28+8)
- Load Dispatch Centers (5)
- Meteorology (sub-divisions) (36)
- Meteorology (reg-centers) (6)
- **Agro-Climatic zones (15)**

Proposed Regional Airsheds for India



- 1-2 Himalayas
- 3-6 Gangetic plains
- 7-10 Plateaus
- 11 Arid lands
- 12-14 Coastal plains
- 15 Islands

Proposed Regional Airsheds for India



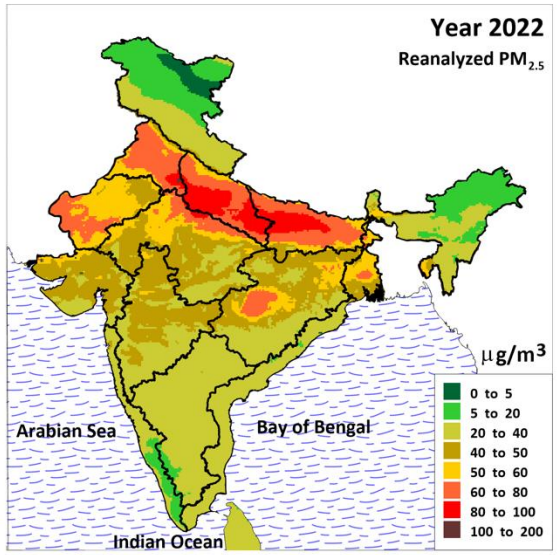


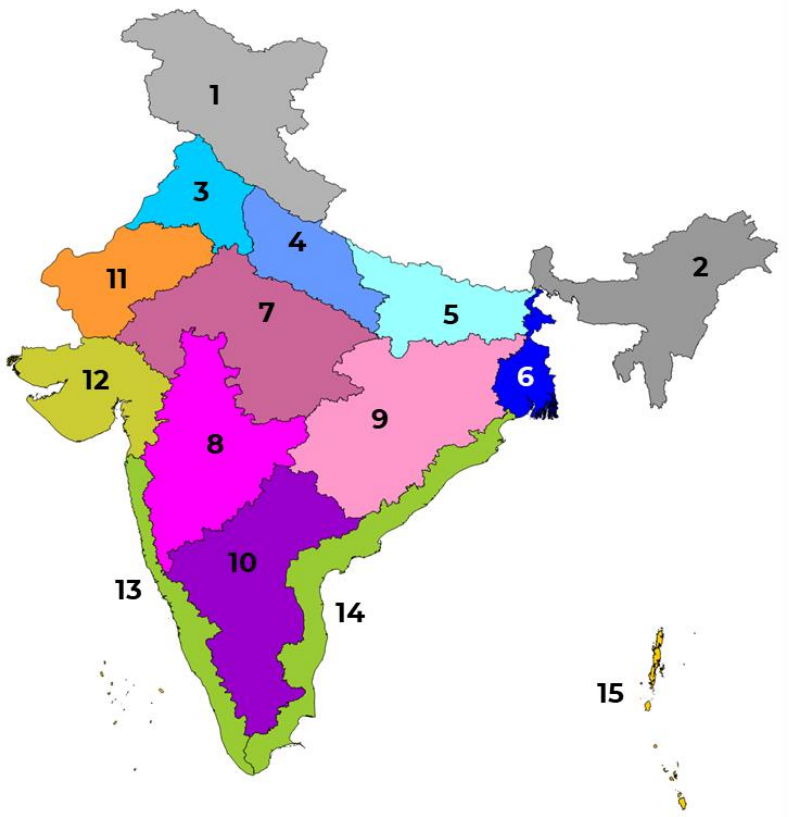
Table 1. Characteristics of the proposed 15 regional airsheds (**Figure 2d**) to support air quality management in India. Population totals are from gridded database from landscan program [16]. Annual average $PM_{2.5}$ concentrations are from global reanalysis fields [15,17].

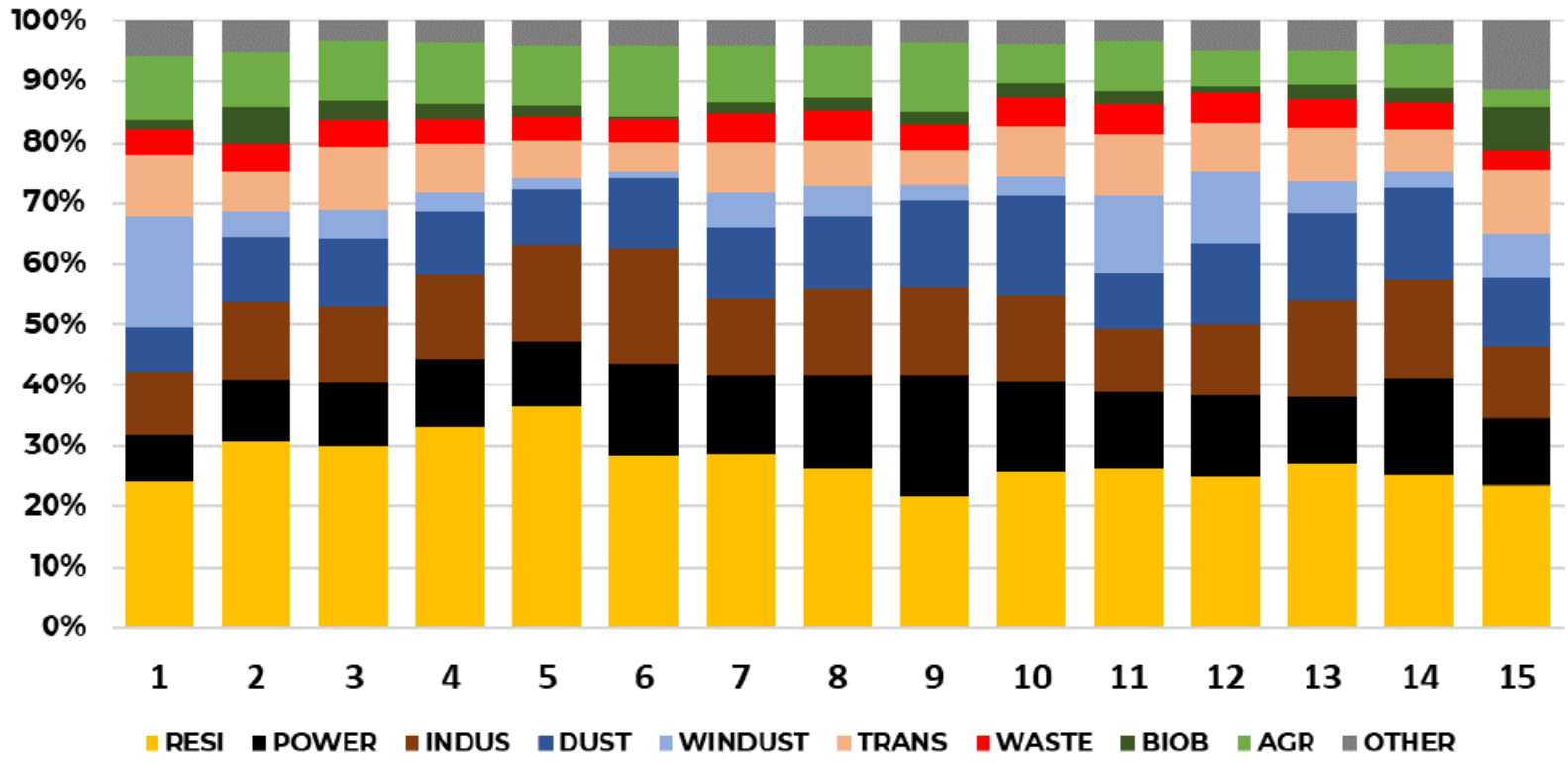
Airshed	Airshed	Major	Percent	Percent	$PM_{2.5}$ Average (µg/m³)		
Code	Name	Urban Center	Landmass	Pop 2021	1998	2022	%increase
1	Western Himalayas	Dehradun	11.0%	2.9%	12.3	16.6	35%
2	Eastern Himalayas	Guwahati	9.1%	4.9%	17.9	22.1	24%
3	Trans Gangetic Plain	Delhi	4.0%	7.3%	42.3	63.8	51%
4	Upper Gangetic Plain	Kanpur	4.1%	10.0%	56.1	75.8	35%
5	Middle Gangetic Plain	Patna	5.5%	15.7%	46.4	68.5	48%
6	Lower Gangetic Plain	Kolkata	2.4%	7.5%	32.9	51.0	55%
7	Central Plateau	Indore	11.3%	10.0%	33.6	47.9	42%
8	Western Plateau	Nagpur	9.1%	7.7%	21.4	40.0	87%
9	Eastern Plateau	Raipur	11.3%	9.2%	27.2	43.0	58%
10	Southern Plateau	Bengaluru	10.0%	9.6%	16.4	27.5	68%
11	Arid Desert	Jaipur	5.2%	2.9%	45.5	57.0	25%
12	Gujarat Coast & Plains	Ahmedabad	5.6%	5.4%	31.0	42.2	36%
13	West Coast	Mumbai	3.8%	4.2%	13.0	23.7	83%
14	East Coast	Chennai	6.8%	2.9%	17.2	26.4	53%
15	Islands	--	0.7%	0.001%	8.3	9.1	9%

TROPOMI Sentinel 5p - Annual Extracts

	Airshed Name	NO_2 ($*10^{-5}$)			SO_2 ($*10^{-5}$)			Ozone ($*10^{-1}$)			HCHO ($*10^{-4}$)		
		2019	2023	%	2019	2023	%	2019	2023	%	2019	2023	%
1	Western Himalayas	5.9	6.1	3%	1.9	2.7	30%	1.2	1.2	1%	0.7	0.8	11%
2	Eastern Himalayas	5.6	6.1	9%	0.3	4.3	92%	1.2	1.2	2%	1.3	1.4	11%
3	Trans Gangetic Plain	8.5	9.3	8%	8.0	9.2	13%	1.2	1.3	2%	1.9	1.9	0%
4	Upper Gangetic Plain	8.2	9.0	9%	6.9	8.4	18%	1.2	1.3	3%	2.0	2.0	2%
5	Middle Gangetic Plain	7.7	8.4	9%	5.8	8.1	28%	1.2	1.2	3%	2.0	2.1	5%
6	Lower Gangetic Plain	8.2	9.4	13%	9.7	15.5	37%	1.2	1.2	3%	1.9	2.1	10%
7	Central Plateau	7.0	7.4	6%	5.7	6.4	12%	1.2	1.2	4%	1.5	1.5	-2%
8	Western Plateau	6.6	7.1	8%	6.2	9.4	34%	1.2	1.2	3%	1.5	1.6	5%
9	Eastern Plateau	7.4	8.1	10%	14.1	18.6	24%	1.2	1.2	3%	1.8	1.8	4%
10	Southern Plateau	6.1	6.7	9%	3.8	6.6	41%	1.2	1.2	3%	1.5	1.6	8%
11	Arid Desert	6.6	7.1	7%	3.8	4.6	18%	1.2	1.3	3%	1.4	1.4	-3%
12	Gujarat Coast & Plains	6.8	7.4	7%	6.0	8.3	28%	1.2	1.2	4%	1.4	1.5	1%
13	West Coast	5.8	6.2	8%	1.8	3.4	48%	1.2	1.2	3%	1.7	1.8	5%
14	East Coast	6.1	6.7	9%	6.1	9.5	36%	1.2	1.2	3%	1.6	1.7	9%
15	Islands	4.2	4.4	5%				1.1	1.2	2%	0.9	0.9	1%

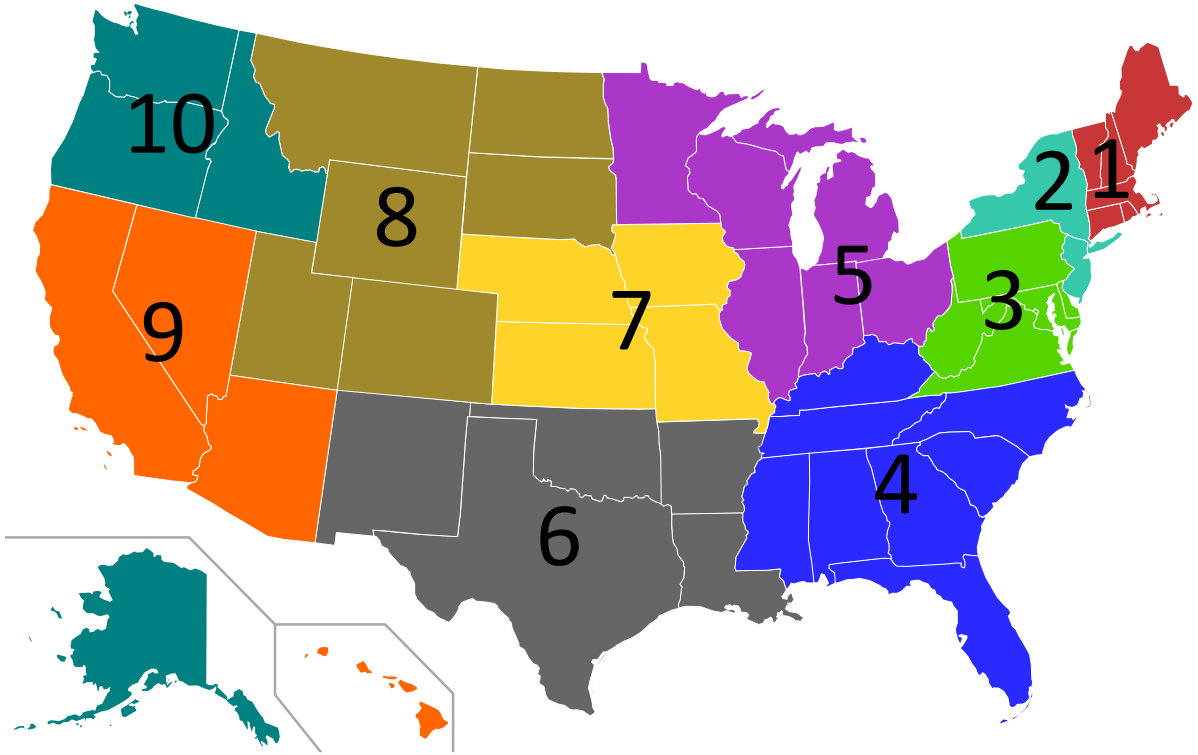
Proposed Regional Airsheds for India





WUSTL Reanalysis Source Apportionment runs

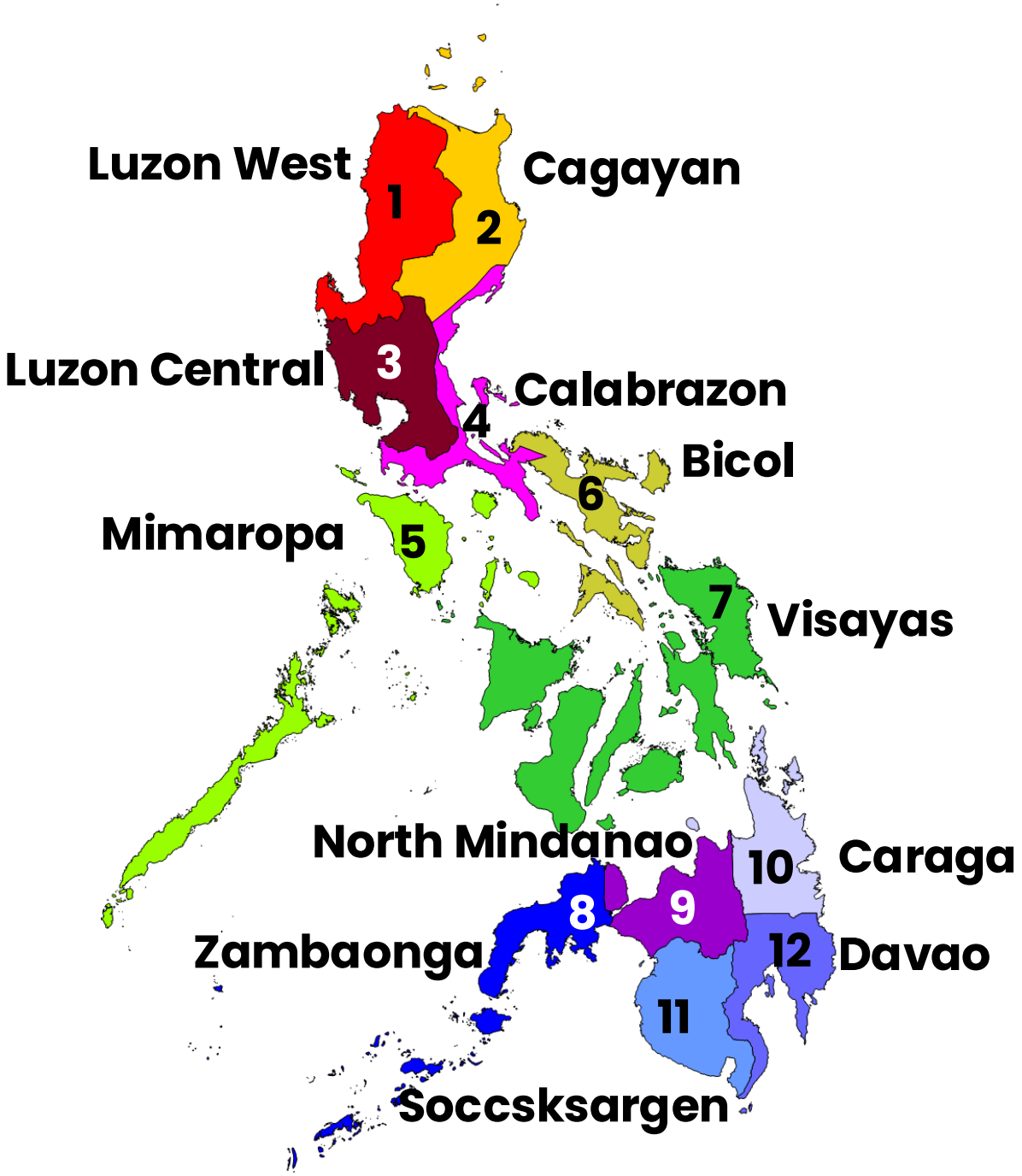
Designated Regional Airsheds (US EPA)



Region 1: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont (New England).
Region 2: New Jersey, New York, US territories of Puerto Rico, and the U.S. Virgin Islands.
Region 3: Delaware, Maryland, Pennsylvania, Virginia, West Virginia, and the District of Columbia.
Region 4: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee.
Region 5: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin.
Region 6: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.
Region 7: Iowa, Kansas, Missouri, and Nebraska.
Region 8: Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming.
Region 9: Arizona, California, Hawaii, Nevada, the territories of Guam and American Samoa, and the Navajo Nation.
Region 10: Alaska, Idaho, Oregon, and Washington.

Proposed Airsheds for Philippines

12


Luzon West
1
Cagayan
2
Luzon Central
3
Calabrazon
4
Bicol
6
Mimaropa
5
7
Visayas
North Mindanao
10
Caraga
8
9
Zambaonga
12
Davao
11
Soccsksargen

Airshed Population

				1000.km2		pop (millions)					
	Airshed Name	gridcount	grid%	area	area%	1998	2010	2020	2022	2022-1998%	2022%
1	Luzon West	274	8.3%	29.1	10.0%	5.7	6.8	7.1	7.3	27.8%	6.4%
2	Cagayan	265	8.0%	27.1	9.3%	3.0	3.7	3.6	3.8	26.8%	3.3%
3	Luzon Central	230	7.0%	25.0	8.6%	24.8	31.1	36.1	38.4	55.0%	33.7%
4	Calabrazon	196	5.9%	14.4	4.9%	4.3	5.1	5.8	6.1	43.3%	5.4%
5	Mimaropa	347	10.5%	23.0	7.9%	2.2	2.8	3.0	3.1	36.5%	2.7%
6	Bicol	240	7.3%	17.1	5.9%	5.1	6.1	6.2	6.4	24.2%	5.6%
7	Visayas	678	20.5%	55.2	18.9%	16.7	20.3	20.8	21.5	28.8%	18.9%
8	Zamboanga	278	8.4%	17.9	6.1%	4.0	5.0	5.5	5.8	44.8%	5.1%
9	North Mindanao	198	6.0%	21.4	7.3%	4.6	5.6	6.1	6.4	38.3%	5.6%
10	Caraga	206	6.2%	19.7	6.8%	2.4	2.9	2.9	3.1	29.6%	2.7%
11	Soccsksargen	213	6.4%	23.6	8.1%	4.1	5.3	6.3	6.7	61.8%	5.9%
12	Davao	181	5.5%	17.8	6.1%	3.9	4.7	5.2	5.4	40.6%	4.8%
				291.2					113.9		

Grid columns corresponds to size is 0.1° resolution

TROPOMI Sentinel 5p - Annual Extracts
NO_2 Airshed Average (mol/m2 * 10^{-5})

	Airshed Name	2019	2020	2021	2022	2023	2020-2019	2023-2019
1	Luzon West	5.36	4.96	5.54	5.08	5.70	-7.5%	6.4%
2	Cagayan	5.36	4.97	5.66	4.89	5.70	-7.2%	6.4%
3	Luzon Central	5.86	5.37	5.93	5.71	6.21	-8.4%	6.0%
4	Calabrazon	5.02	4.67	5.31	4.88	5.51	-6.9%	9.7%
5	Mimaropa	3.85	3.64	4.03	3.94	4.08	-5.3%	5.9%
6	Bicol	4.52	4.31	4.77	4.46	4.92	-4.5%	8.8%
7	Visayas	4.36	4.15	4.54	4.48	4.62	-4.7%	6.0%
8	Zamboanga	3.92	3.84	4.21	4.29	4.16	-2.2%	6.1%
9	North Mindanao	4.17	4.13	4.43	4.46	4.47	-1.0%	7.2%
10	Caraga	4.00	3.95	4.36	4.30	4.45	-1.2%	11.2%
11	Soccsksargen	4.08	4.10	4.37	4.44	4.30	0.4%	5.5%
12	Davao	3.91	3.91	4.29	4.30	4.25	0.0%	8.6%

TROPOMI Sentinel 5p - Annual Extracts
SO_2 Airshed Average (mol/m2 * 10^{-5})

	Airshed Name	2019	2020	2021	2022	2023	2020-2019	2023-2019
1	Luzon West	1.39	1.96	1.31	-0.55	1.60	41.5%	15.3%
2	Cagayan	1.76	2.70	3.78	2.48	4.04	53.0%	129.3%
3	Luzon Central	2.12	2.07	2.66	3.48	4.22	-2.6%	98.6%
4	Calabrazon	1.84	2.74	5.87	7.38	8.23	49.1%	348.3%
5	Mimaropa	2.15	1.39	2.63	3.36	3.40	-35.7%	57.7%
6	Bicol	3.61	4.62	5.20	6.58	6.20	27.9%	71.7%
7	Visayas	1.53	2.42	3.15	4.16	3.84	57.7%	150.7%
8	Zamboanga	1.43	2.66	5.93	7.92	4.50	85.6%	214.4%
9	North Mindanao	1.62	1.58	3.93	4.32	3.86	-1.9%	138.8%
10	Caraga	2.43	2.39	3.56	5.22	4.16	-2.0%	70.7%
11	Soccsksargen	2.42	2.31	3.41	4.33	3.04	-4.6%	25.5%
12	Davao	3.13	2.39	3.16	4.28	3.60	-23.5%	15.3%

TROPOMI Sentinel 5p - Annual Extracts
O_3 Airshed Average (mol/m2 * 10^{-1})

	Airshed Name	2019	2020	2021	2022	2023	2020-2019	2023-2019
1	Luzon West	1.13	1.20	1.21	1.18	1.16	6.3%	2.5%
2	Cagayan	1.20	1.23	1.25	1.24	1.22	3.0%	2.1%
3	Luzon Central	1.16	1.21	1.21	1.19	1.18	4.3%	1.9%
4	Calabrazon	1.18	1.21	1.22	1.22	1.21	2.9%	2.9%
5	Mimaropa	0.99	1.03	1.03	1.04	1.03	3.2%	3.3%
6	Bicol	1.17	1.21	1.21	1.21	1.20	3.4%	3.3%
7	Visayas	1.16	1.18	1.19	1.21	1.19	2.1%	3.2%
8	Zamboanga	1.15	1.14	1.16	1.19	1.16	-1.0%	1.1%
9	North Mindanao	1.15	1.15	1.15	1.20	1.18	0.1%	2.2%
10	Caraga	1.16	1.17	1.19	1.22	1.19	0.5%	2.6%
11	Soccsksargen	1.16	1.15	1.16	1.19	1.17	-0.4%	0.8%
12	Davao	1.15	1.16	1.17	1.19	1.18	0.6%	2.5%

TROPOMI Sentinel 5p - Annual Extracts HCHO Airshed Average (mol/m2 * 10^{-4})

	Airshed Name	2019	2020	2021	2022	2023	2020-2019	2023-2019
1	Luzon West	1.34	1.25	1.27	1.13	1.25	-6.4%	-6.8%
2	Cagayan	1.23	1.12	1.21	1.04	1.13	-9.4%	-8.0%
3	Luzon Central	1.42	1.28	1.27	1.21	1.28	-9.6%	-9.9%
4	Calabrazon	1.17	1.03	1.03	0.98	1.09	-11.8%	-6.6%
5	Mimaropa	0.89	0.85	0.81	0.78	0.84	-3.7%	-5.1%
6	Bicol	0.96	0.90	0.86	0.79	0.92	-6.3%	-4.8%
7	Visayas	1.03	0.98	0.88	0.86	0.94	-4.8%	-8.9%
8	Zamboanga	1.07	1.09	0.90	0.86	1.00	1.7%	-6.5%
9	North Mindanao	1.17	1.22	0.92	0.83	0.99	4.5%	-15.8%
10	Caraga	1.03	0.85	0.91	0.84	0.99	-17.4%	-3.2%
11	Soccsksargen	1.28	1.23	1.03	0.90	1.10	-3.5%	-13.4%
12	Davao	1.06	0.96	0.95	0.81	1.00	-10.0%	-5.9%

TROPOMI Sentinel 5p - Annual Extracts
UVAI Airshed Average

	Airshed Name	2019	2020	2021	2022	2023	2020-2019	2023-2019
1	Luzon West	-1.29	-1.58	-1.33	-0.73	-0.64	-22.2%	50.9%
2	Cagayan	-1.31	-1.55	-1.29	-0.72	-0.62	-18.3%	52.9%
3	Luzon Central	-1.31	-1.61	-1.39	-0.69	-0.62	-23.1%	52.9%
4	Calabrazon	-1.34	-1.57	-1.36	-0.75	-0.70	-16.7%	47.7%
5	Mimaropa	-1.14	-1.37	-1.17	-0.65	-0.59	-20.8%	48.3%
6	Bicol	-1.35	-1.64	-1.34	-0.75	-0.71	-20.8%	47.9%
7	Visayas	-1.34	-1.62	-1.33	-0.80	-0.72	-21.3%	46.0%
8	Zamboanga	-1.38	-1.64	-1.33	-0.83	-0.75	-18.8%	45.4%
9	North Mindanao	-1.36	-1.62	-1.33	-0.89	-0.82	-19.1%	39.5%
10	Caraga	-1.44	-1.71	-1.35	-0.88	-0.82	-18.1%	43.2%
11	Soccsksargen	-1.40	-1.66	-1.37	-0.85	-0.79	-18.5%	43.6%
12	Davao	-1.40	-1.65	-1.36	-0.87	-0.80	-18.1%	42.7%

MODIS-MAIAC - Annual Extracts
AOD Airshed Average

	Airshed Name	2019	2020	2021	2022	2023	2020-2019	2023-2019
1	Luzon West	0.09	0.08	0.10	0.05	0.07	4.5%	18.5%
2	Cagayan	0.10	0.10	0.12	0.07	0.08	2.6%	13.9%
3	Luzon Central	0.11	0.10	0.12	0.08	0.09	5.2%	12.7%
4	Calabrazon	0.09	0.09	0.12	0.07	0.08	-2.8%	10.3%
5	Mimaropa	0.08	0.08	0.09	0.06	0.06	3.0%	23.1%
6	Bicol	0.10	0.10	0.12	0.07	0.08	0.2%	20.6%
7	Visayas	0.09	0.09	0.12	0.07	0.07	-4.9%	19.7%
8	Zamboanga	0.09	0.09	0.10	0.07	0.07	3.5%	18.6%
9	North Mindanao	0.09	0.08	0.10	0.06	0.06	9.9%	28.2%
10	Caraga	0.09	0.07	0.08	0.06	0.06	23.8%	36.6%
11	Soccsksargen	0.10	0.09	0.11	0.08	0.07	11.7%	27.7%
12	Davao	0.09	0.09	0.10	0.06	0.07	7.4%	29.7%

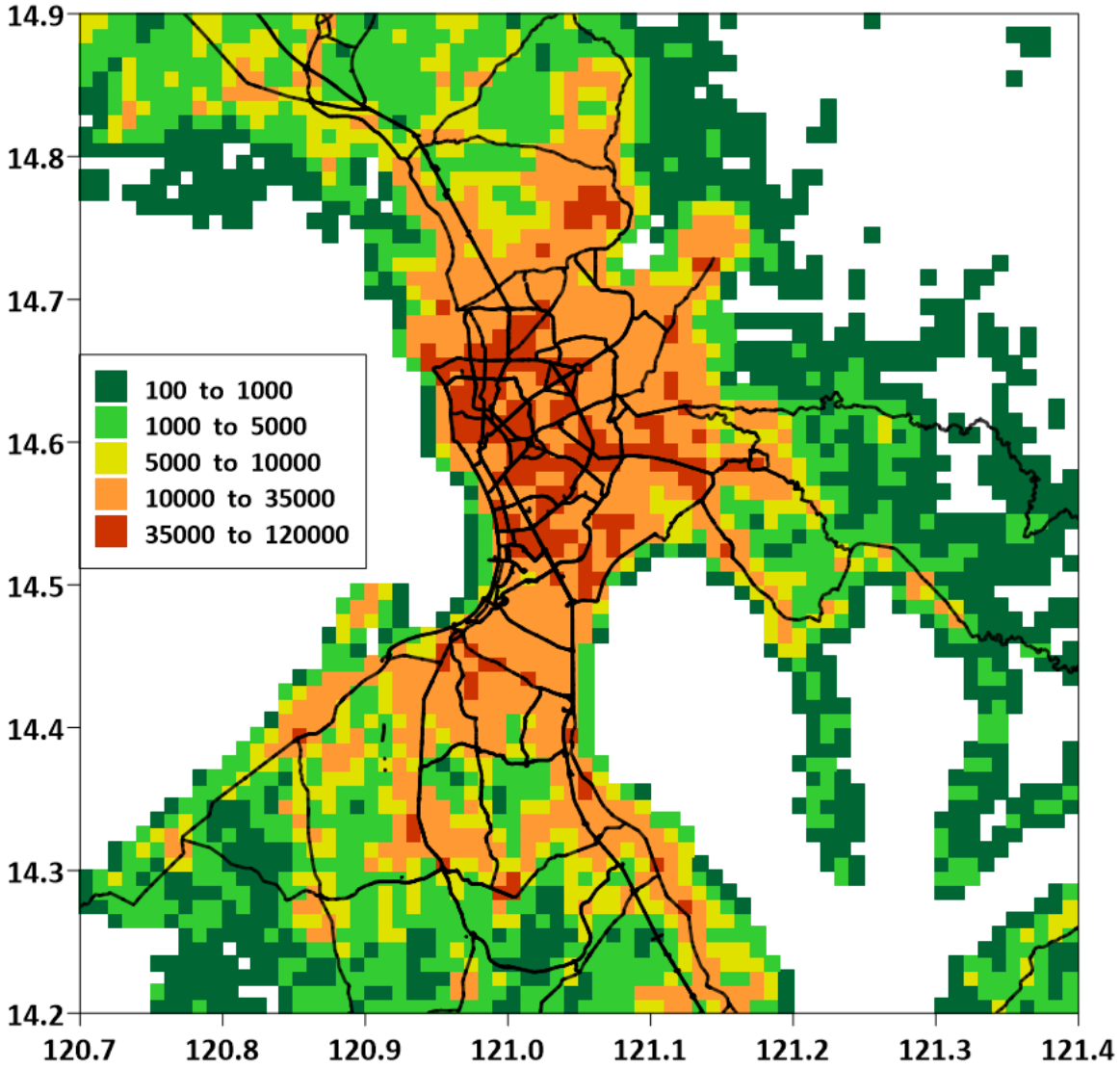
$PM_{2.5}$ Reanalysis Fields 1998-2022
Airshed Averages

	Airshed Name	gridcount	grid%	1998	2010	2020	2022	2022-1998%
1	Luzon West	274	8.3%	18.0	21.7	18.4	19.2	7.0%
2	Cagayan	265	8.0%	13.5	15.4	13.2	14.2	5.3%
3	Luzon Central	230	7.0%	17.4	20.7	19.6	21.3	22.4%
4	Calabrazon	196	5.9%	12.6	13.4	12.3	14.0	10.6%
5	Mimaropa	347	10.5%	13.9	13.1	12.4	14.1	1.2%
6	Bicol	240	7.3%	14.1	14.6	14.5	15.9	12.8%
7	Visayas	678	20.5%	15.1	18.0	17.8	19.6	30.0%
8	Zamboanga	278	8.4%	13.2	14.7	13.8	16.1	22.0%
9	North Mindanao	198	6.0%	15.7	22.7	20.9	25.6	62.4%
10	Caraga	206	6.2%	14.8	19.7	18.8	21.6	45.8%
11	Soccsksargen	213	6.4%	16.1	22.7	20.9	25.1	56.1%
12	Davao	181	5.5%	13.6	19.5	19.0	21.6	58.9%

$PM_{2.5}$ Reanalysis Fields 1998-2022
Airshed Maxima
(proxy for the urbanized area)

	Airshed Name	gridcount	grid%	1998	2010	2020	2022	2022-1998%
1	Luzon West	274	8.3%	30.6	40.5	35.3	37.0	20.9%
2	Cagayan	265	8.0%	30.5	39.6	35.7	37.3	22.3%
3	Luzon Central	230	7.0%	24.9	32.3	31.9	34.3	37.8%
4	Calabrazon	196	5.9%	20.1	23.5	21.8	23.8	18.4%
5	Mimaropa	347	10.5%	19.0	21.7	22.2	25.0	31.6%
6	Bicol	240	7.3%	17.5	20.4	21.9	24.7	41.1%
7	Visayas	678	20.5%	20.6	24.5	25.5	28.8	39.8%
8	Zamboanga	278	8.4%	19.5	23.9	23.3	28.2	44.6%
9	North Mindanao	198	6.0%	19.9	29.9	29.5	34.7	74.4%
10	Caraga	206	6.2%	18.8	28.3	25.3	29.6	57.4%
11	Soccsksargen	213	6.4%	19.3	30.1	29.1	35.2	82.4%
12	Davao	181	5.5%	18.4	27.4	25.8	30.8	67.4%

Urban Airshed – Greater Manila (Roads & Population)

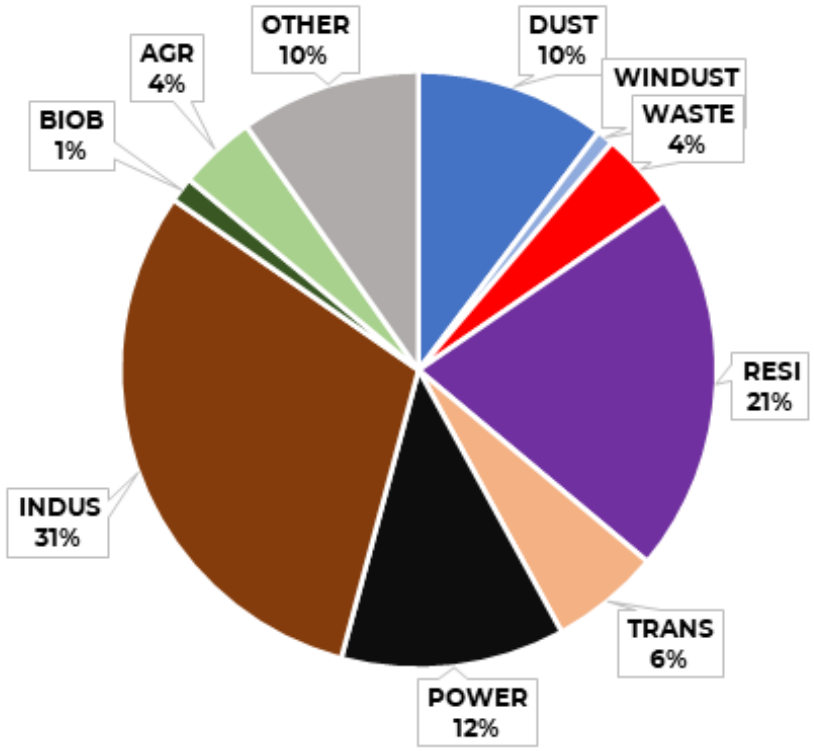


Airshed size = 70 x 70 grids
Grid size = 0.01º (~1km)

Primary roads = 2300 km
Secondary roads = 2100 km
All roads = 49,000 km
From openstreetmaps

Total population 2022
Airshed = 26.9 million
Metro = 17.8 million
From LANDSCAN

Urban Airshed – Greater Manila ($PM_{2.5}$)
WUSTL GBDMAPS Source Apportionment



National Segment

ESCAP
Economic and Social Commission for Asia and the Pacific

Bhutan

- Scene Setting (ESCAP: 5 min)
- National Perspective (15 Min: Ministry/City) Needs, similar projects, sustainability and harmonization opportunities
- Questions & Answers(10 Min)





Tackling Household Air Pollution

1

Promote Clean Cooking Solutions

Encourage the use of clean cooking stoves and fuels to reduce indoor air pollution, which is a significant health hazard.

2

Enhance Ventilation

Improve ventilation in homes to reduce the concentration of indoor pollutants. pollutants.

3

Awareness Campaigns

Conduct awareness campaigns about the health impacts of indoor air pollution and pollution and the benefits of clean cooking and heating technologies.

Reducing Industrial Air Pollution

Pollution Control Equipment

Mandate the installation and and proper operation of pollution control equipment equipment such as electrostatic electrostatic precipitators in industries like cement plants. plants.

Emission Standards

Enforce strict emission standards for industries and monitor compliance regularly.

Industrial Zoning

Implement zoning regulations to regulations to keep industrial industrial activities away from from residential areas to minimize exposure to harmful harmful pollutants.

Addressing Transportation Air Pollution

1

Vehicle Emission Standards

Enforce stricter vehicle emission standards and regularly inspect vehicles for compliance.

2

Promote Electric Electric Vehicles Vehicles

Encourage the use of of electric vehicles through incentives and develop the necessary infrastructure for EVs. EVs.

3

Public Transportation

Improve and expand expand public transportation systems to reduce the number of private vehicles on the road.

4

Traffic Management

Implement intelligent intelligent traffic management systems systems to reduce congestion and associated emissions. emissions.

Cross-Sectoral Actions for Air Quality Improvement

1

Air Quality Monitoring

Establish a comprehensive air quality monitoring network to identify pollution hotspots and track progress.

2

Legislation and Policy Policy

Strengthen environmental environmental legislation legislation and policies related to air quality management.

3

International Collaboration

Engage in regional cooperation to address transboundary air pollution issues.

4

Research and Development

Invest in research to better understand the the sources and impacts of air pollution and to and to develop innovative solutions.

5

Public Engagement

Involve communities in air quality improvement initiatives and decision-making making processes.



Bhutan National Presentation

Needs, similar projects, sustainability and harmonization opportunities

Strengthening Regional Cooperation To Tackle Air Pollution Challenges In Asia And The Pacific

Regional Inception Workshop

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific



Guiding questions

- National Perspective
  - What are the highest priority needs at the national and municipal level?
  - What similar projects have been recently undertaken?
  - Are there opportunities for sustainability or harmonization?

Scientific Understanding
  - Are there any specific areas which need to be studied in order to make informed policy choices?

What areas should be considered first for financial assistance?
  - Improved data centers for analyzing satellite data?
  - Procuring air quality sensors for installation in the cities?
  - Supporting public health interventions?

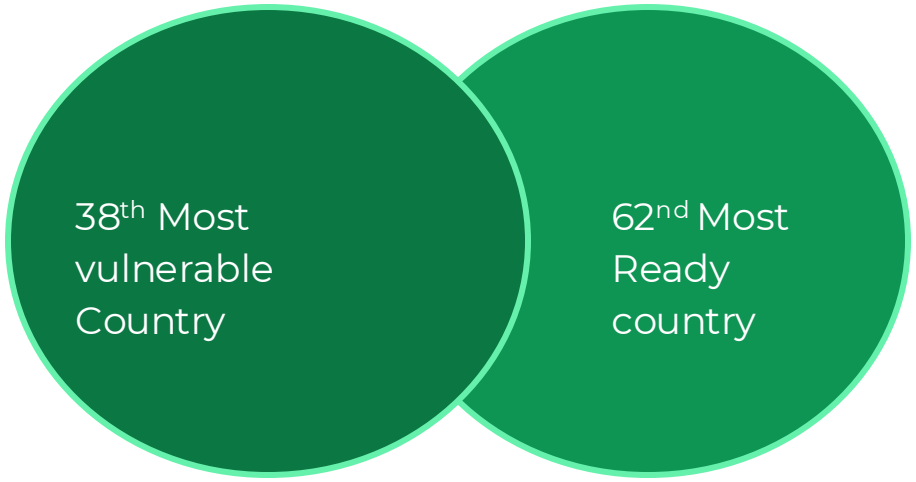
BRIEF BACKGROUND OF BHUTAN

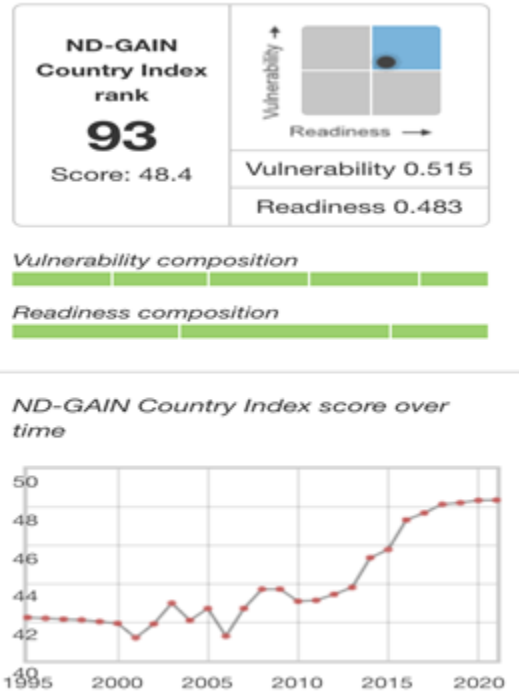
- Tiny Himalayan Kingdom covering an area of 38, 390 sq km.
- Population: 763,249 (0.7 million)
- Gross National Happiness as developmental framework.
    - The concept implies that sustainable development should take a holistic approach and emphasizes the importance of ensuring the overall happiness of the people without being sidetracked with the statistics of Gross Domestic Product (GDP).
- One of the pillar of GNH is environment conservation.



BRIEF BACKGROUND OF BHUTAN

- One of the three carbon neutral country. And has pledge to remain carbon neutral for all times to come at COP15 in 2009.
- Global emission contribution is 0.00%.
- Conservation of forest is constitutional mandate- at least 60% of land must be protected under forest cover.
    - 70% of Land under forest cover
    - More than half of country falls under protected area.





BRIEF BACKGROUND OF BHUTAN

- Bhutan has stringent environmental regulation.
- EIA is primary to any developmental activities.
- We have developed Environment standard 2020 which impose stringent air quality standards

4. Ambient Air Quality Criteria

Parameter		Unit	Industrial area	Mixed Area*	Sensitive area**
Total Suspended Particulate Matter	24-hour average	µg/m³	500	200	100
	Yearly average	µg/m³	360	140	70
PM 2.5[12]	24-hour average	µg/m³	60	60	60
	Yearly average	µg/m³	40	40	40
PM 10	24-hour average	µg/m³	200	100	75
	Yearly average	µg/m³	120	60	50
Sulfur Dioxide (SO2)	24-hour average	µg/m³	120	80	30
	Yearly average	µg/m³	80	60	15
Nitrogen Oxides (NOx)	24-hour average	µg/m³	120	80	30
	Yearly average	µg/m³	80	60	15
Carbon Monoxide	8-hour average	µg/m³	5,000	2,000	1,000
	1-hour average	µg/m³	10,000	4,000	2,000
Ozone[13]	8-hour average	µg/m³	100	100	100
	1-hour average	µg/m³	180	180	180

***Mixed Area** means area where residential, commercial or both activities take place

****Sensitive Area** means area where sensitive targets are in place like hospitals, schools, sensitive ecosystems

BRIEF BACKGROUND OF BHUTAN



- Bhutan’s development imperative is increasing.
- Green and balanced socio-economic development has become more important and relevant than ever.
- The Gelephu Mindfulness City-Special Administrative Region (SAR) is a visionary undertaking announced by His Majesty King Jigme Khesar Namgyel Wangchuck on Bhutan’s National Day, 17 December 2023.





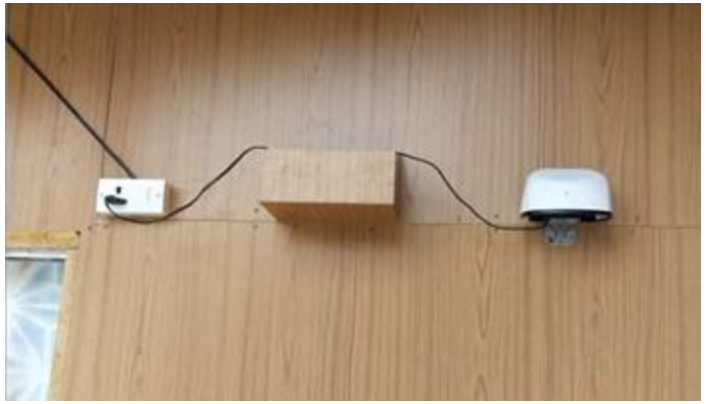


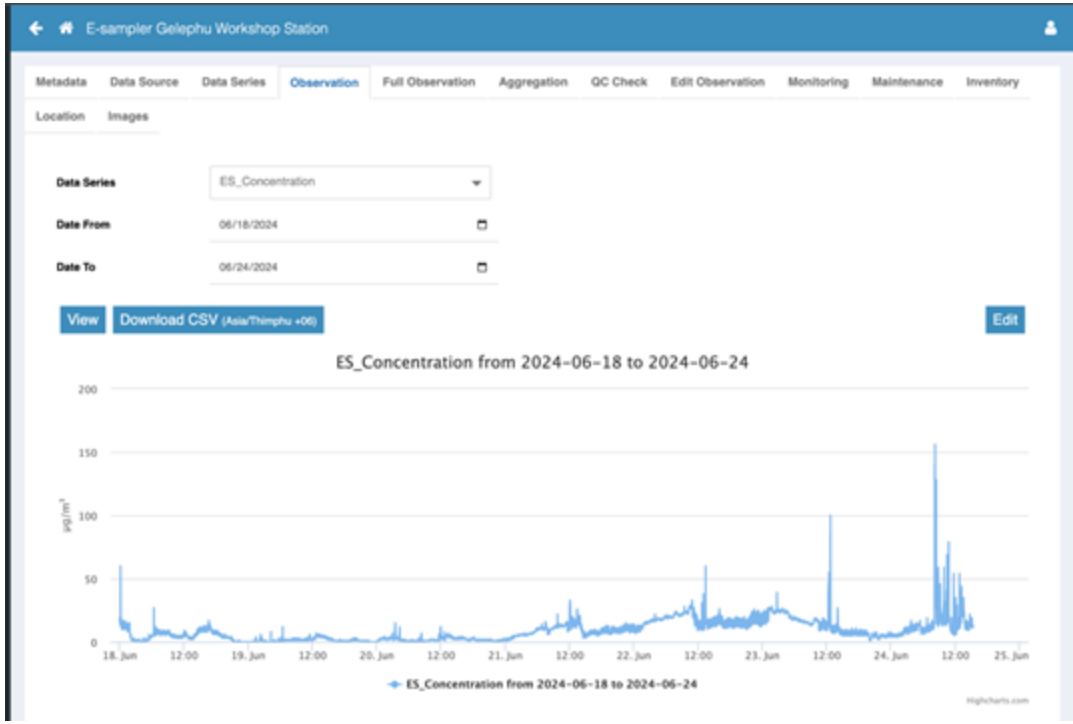
AQ Monitoring network in Gelephu

- 3 e-samplers that can measure PM 2.5 has been installed
- One blue sky low cost sensor









Priorities for Bhutan

- Enhancement of current AQ Monitoring
  - going beyond PM 2.5 to other gaseous and particulate parameters
  - have adequate baseline data to understand trend over the period as the city gets built up
- Bhutan is also looking forward to establishing more automated AQMS going up from low-cost e-samplers. We can keep the option open for now considering the budget availability shared by ESCAP.
- Institutional capacity building for both DECC and Gelephu Municipal Office
  - fixing the samplers
  - data analysis and;
  - information dissemination
- centralised Database can be used to host data collected through this project.

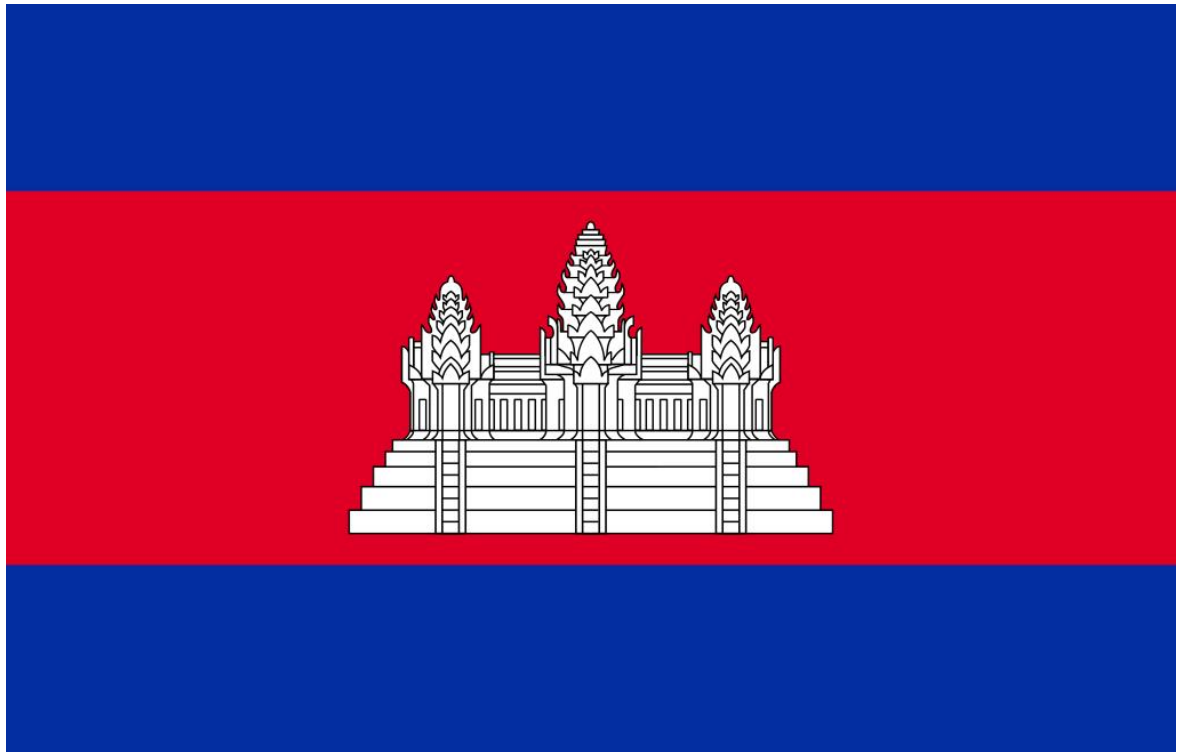
QUESTION AND ANSWER

UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific



Cambodia

- Scene Setting (ESCAP: 5 min)
- National Perspective (15 Min: Ministry/City) Needs, similar projects, sustainability and harmonization opportunities
- Questions & Answers(10 Min)



Scene Setting: Cambodia



MAIN LOCAL SOURCES OF AIR POLLUTION



SUMMARY OF TRANSBOUNDARY EFFECTS



CURRENT EFFORTS



PROPOSED ACTION AREAS

Main Local Sources of Air Pollution







1.Industrial Operations. The garment, cement, brick kiln, rice mill, and rubber processing industries.

2.Transport: sources like cars and other mobile sources.

3.Generation of electricity: Power plants and other energy-producing facilities release pollutants into the atmosphere.

4.Residential Construction: Burning fuel for cooking and heating

5.Construction and Infrastructure: building construction and road development,

Summary of Transboundary Effects

- Cambodia faces significant air pollution issues, with its 16.5 million population exposed to pollutants exceeding WHO guideline.
- Pollutants released are majorly, PM2.5, SOX, NOX, CO, CO2, O3, TSP.
- 42.4 million metric tons of CO2 equivalent were created in Cambodia in 2020, which is equivalent to 0.09% of the world's total greenhouse gas emissions. Signifying a 1% rise from 2019.
- Yearly Trends: With 41,947.80 million metric tons of emissions in 2019, Cambodia exhibited an 11.8% rise over 2018.

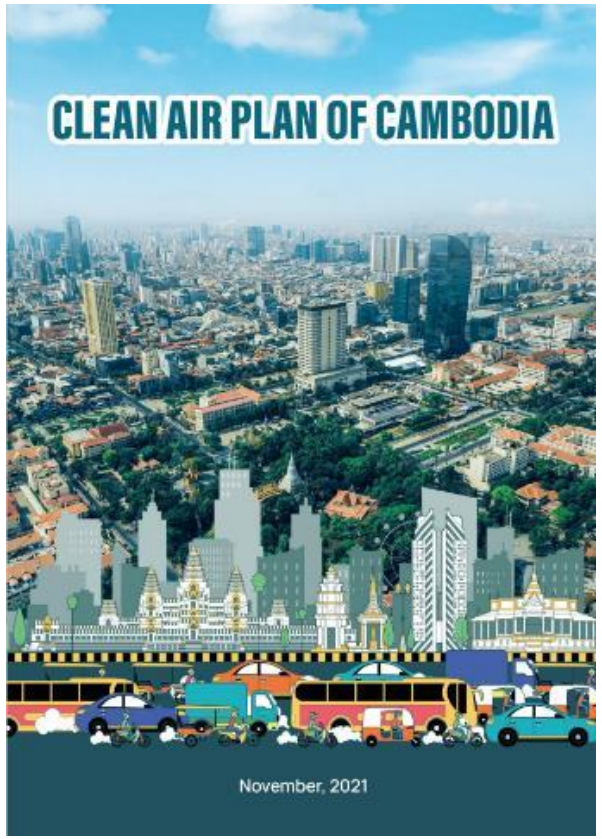
Sources: (Pak Sokharavuth et.al 2023), (IQAir, 2024).

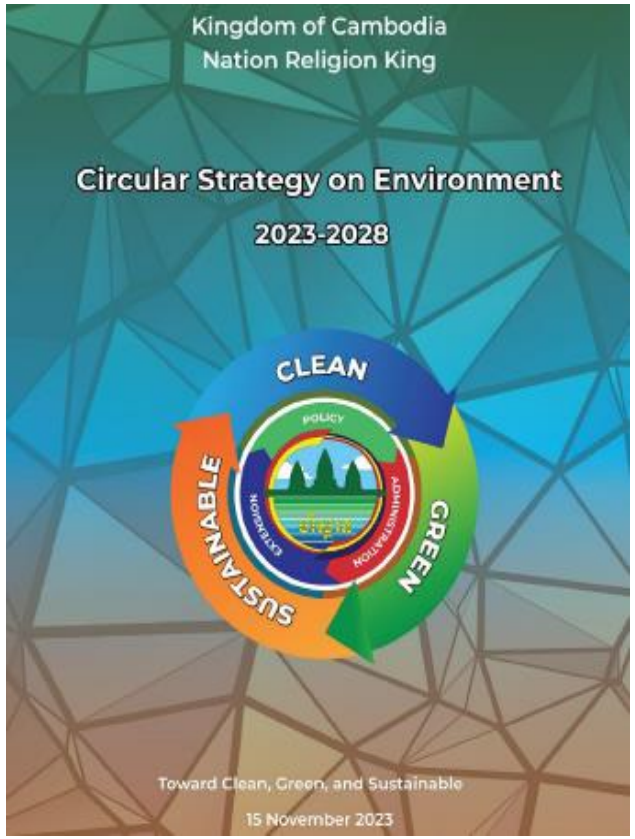
Summary of Transboundary Effects

- **Aerosol (Haze Problems)**: Cambodia, Thailand and other SEA face annual haze problems affecting public health.
- **PM2.5 Pollution**: Airborne pollution from Cambodia, particularly PM2.5 particles, has been observed crossing into Thai provinces such as Sa Kaeo and Prachin Buri, prompting
- *Six provinces in the Northeast were found to have PM2.5 pollution in the "red level", ranging between 76 and 90 micrograms per cubic metre of air (µg/m3). PM2.5 above 35 µg/m3 over 24 hours is considered unhealthy*

Sources:
Qinqin Chen & David Taylor (2018),
cambodianess.com/article/cambodia-and-thailand-commit-to-tackle-transboundary-smog-and-pollution,
www.nationthailand.com/thailand/general/40035270
www.thestar.com.my/aseanplus/aseanplus-news/2024/02/02/thailand-strengthens-cooperation-with-cambodia-against-trans-border-pollution

Current Efforts





- Clean Air Plan of Cambodia

- To help lower harmful pollutants by 60% if it is carried out in full.
- To reduce emissions of carbon dioxide and methane—two major contributors to climate change—by 18% and 24%, respectively, by 2030.
- Cambodia might be able to avert over 900 preventable deaths annually.
- Ensure environmental sustainability and environmental perfection responding to climate change and promoting green development.

Proposed Action Areas

- Monitoring of Infrastructure: Need to enhance resources and capability for upkeep and repairs of the 40 sensors spread over 24 provinces and 10 reference stations
- Cambodia's Clean Air Action Plan: Imperativeness of putting the key initiatives from this plan into practice.
- Build knowledge regarding pollutant sources, emissions, and air quality levels.
- Capacity build for air quality management focusing on technical skills and human resources.
- Building stakeholders consensus for implementing the plan.



Cambodia National Presentation

Needs, similar projects, sustainability and harmonization opportunities

Strengthening Regional Cooperation To Tackle Air Pollution Challenges In Asia And The Pacific

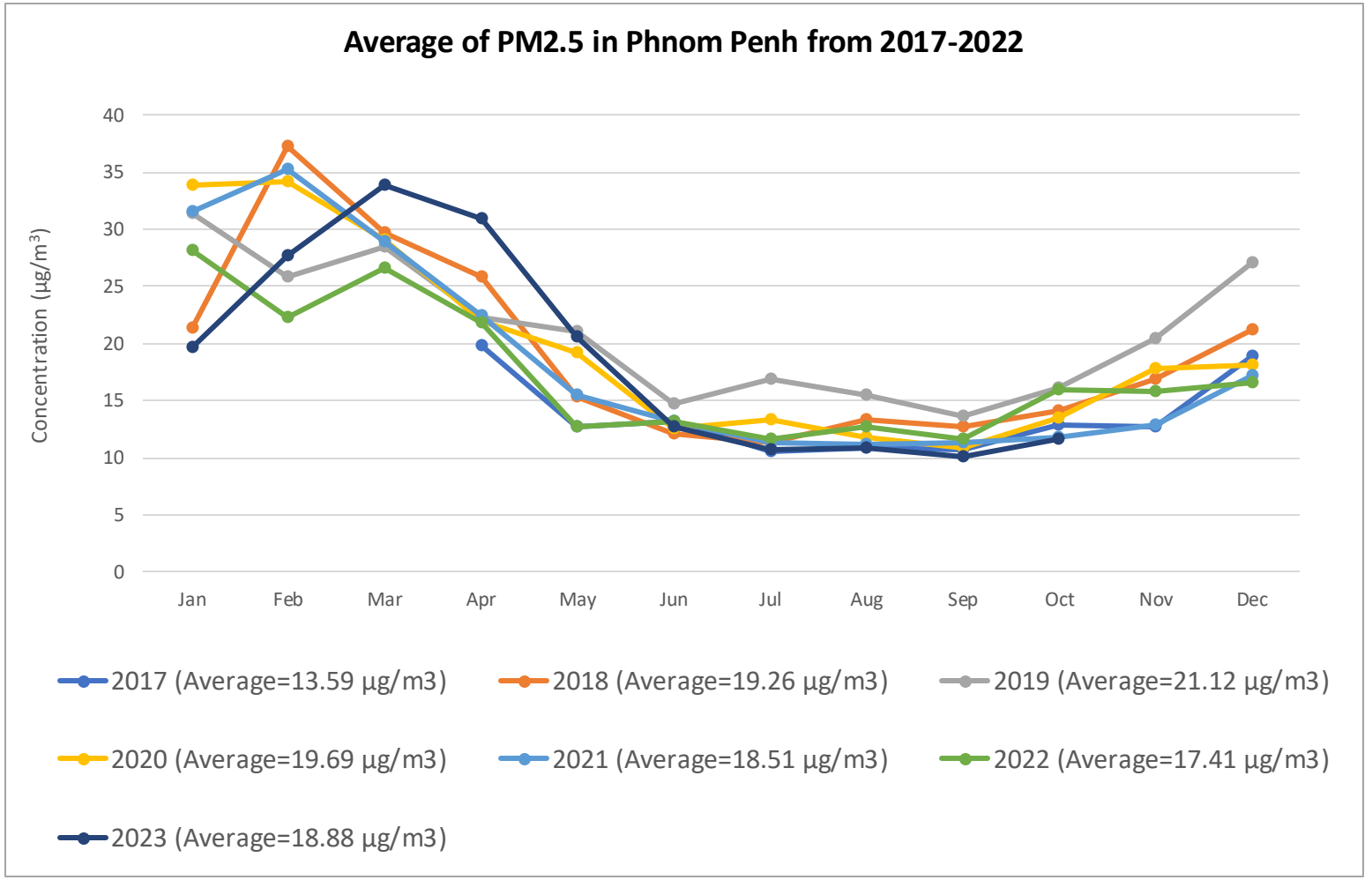
Regional Inception Workshop
Cambodia

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific



Image credit: V.T. Polywo

Trend of air pollution in Cambodia



Source of air pollution

- 1- Mobile Source: Rapid growth in the use of vehicles, especially older vehicles with the use of low quality fuels. From 1990 to mid-2022, there were a total of 6,678,975 registered motorcycles and cars.

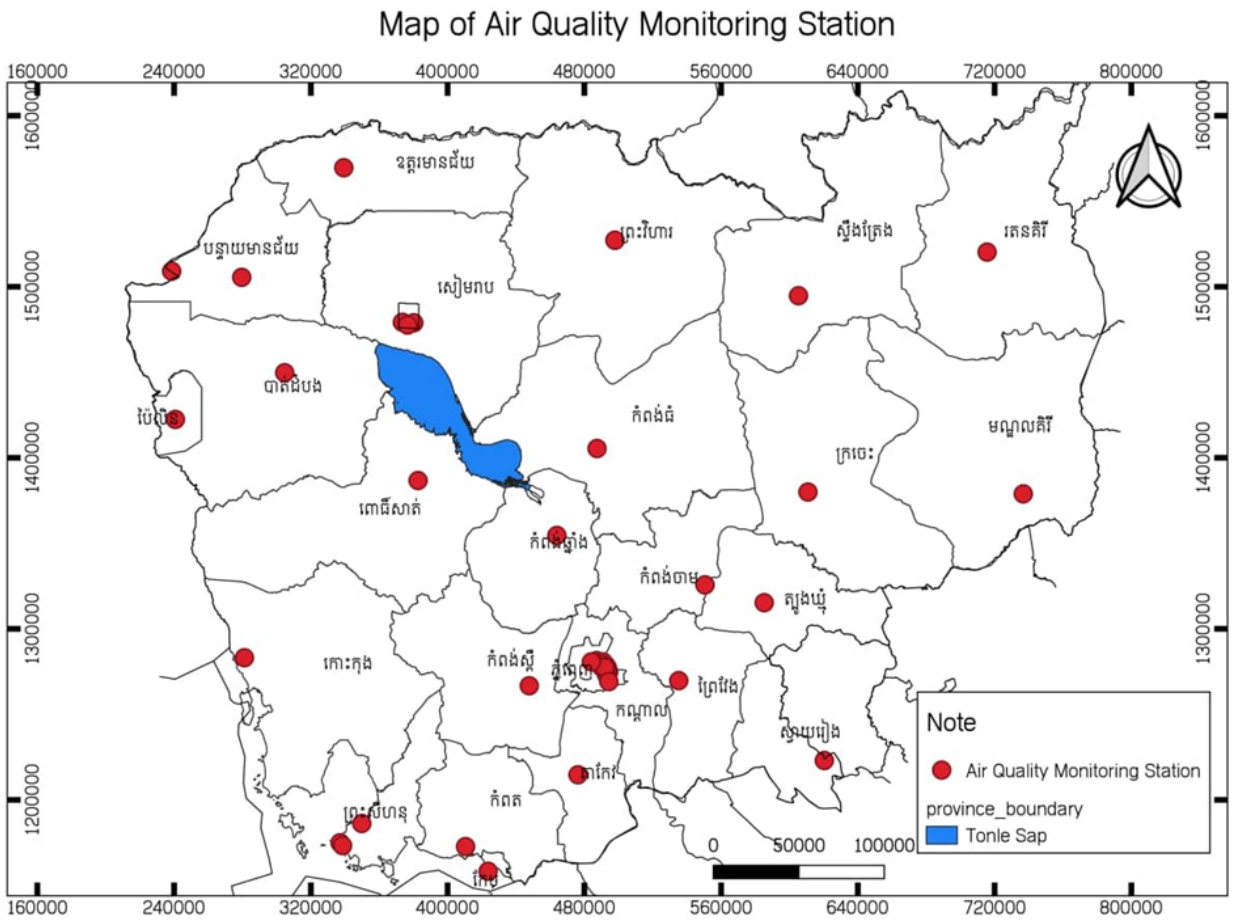
- 2- Stationary Source: Some industries and handicrafts are not yet equipped with air pollution treatment and clean fuel consumption considerations. As of 2023, there are about 2000 industrial plants in operation.

- 3- Construction sites: construction sites, buildings, roads, sewers, bridges. Statistically, the registered construction area in 2018 was 12,364,768 m2, in 2019 was 23,223,998 m2 and in 2020 was 8,535,476 m2.

- 4- Other Sources: Burning of agricultural waste, forest fires, landfill fires (intentional and unintentional), incineration of residential waste and commercial agriculture. Number of Hotspot for the year 2020 = 28 838, 2021 = 26 339, 2022 = 16 232



Air quality Management









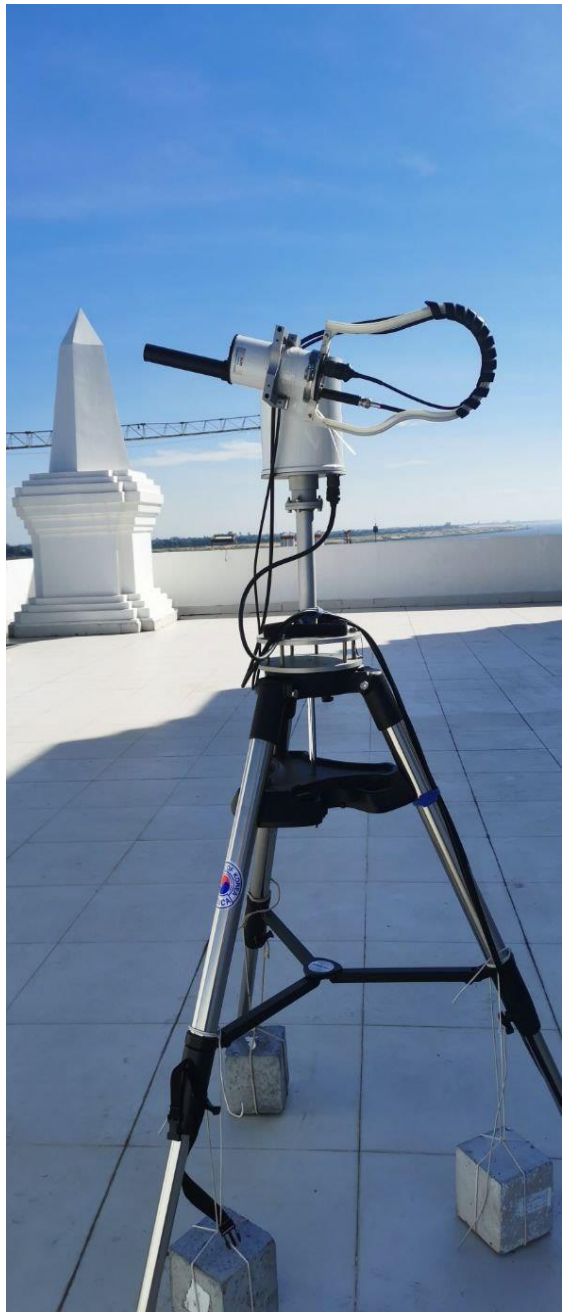




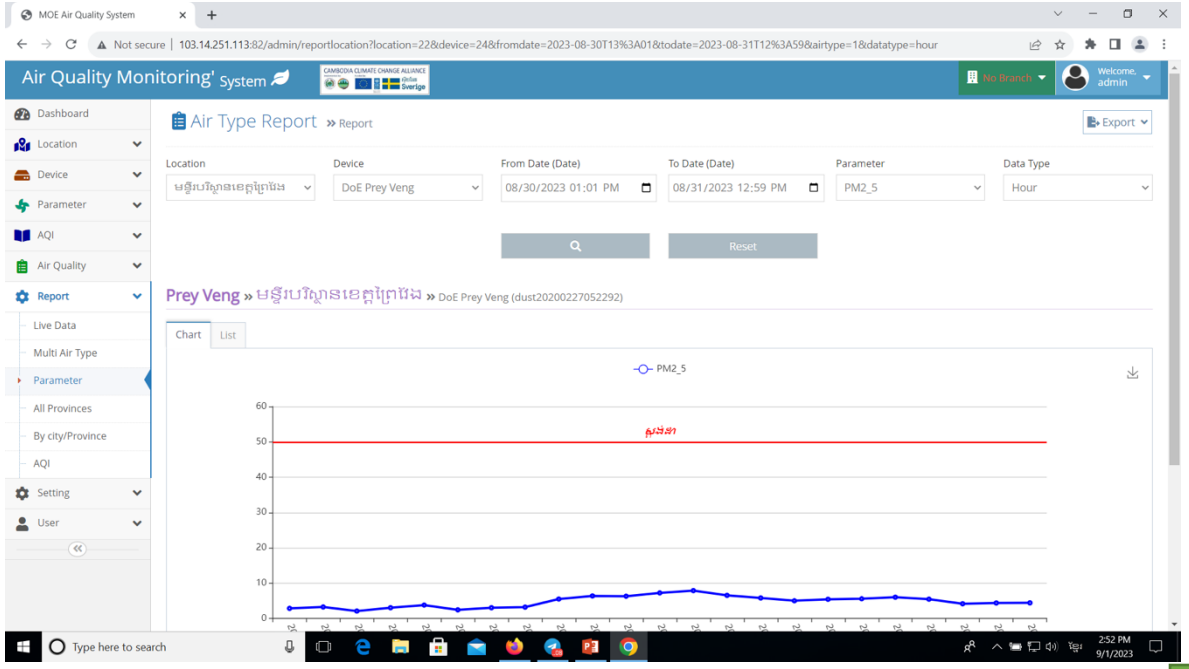


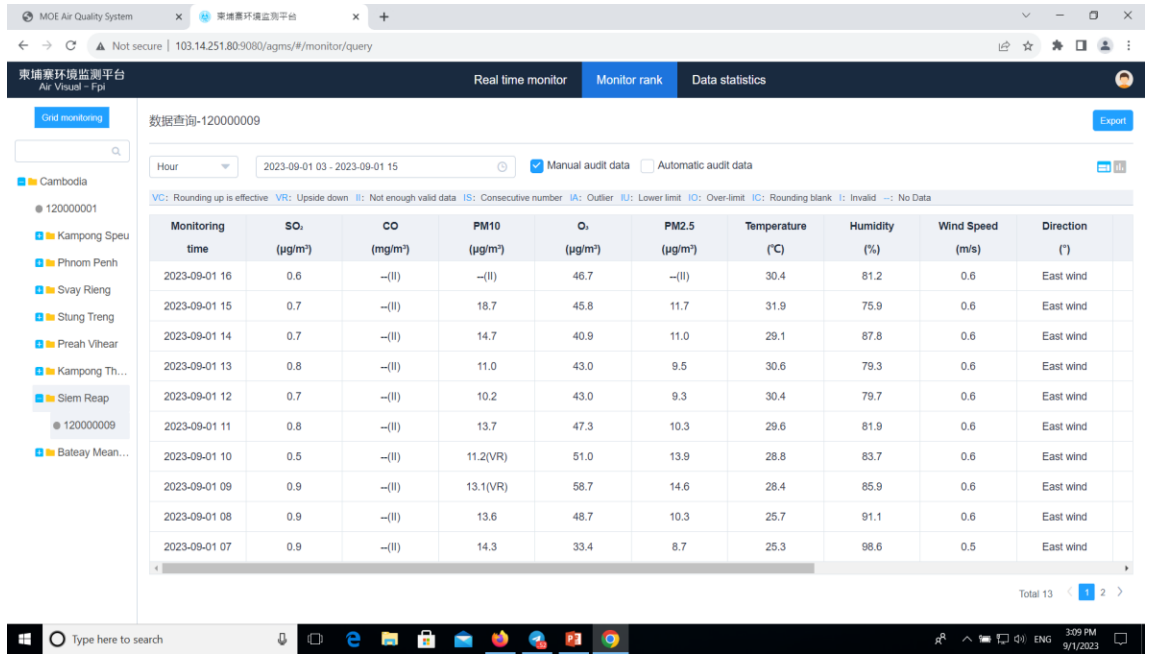

Vishno Air Quality Monitoring

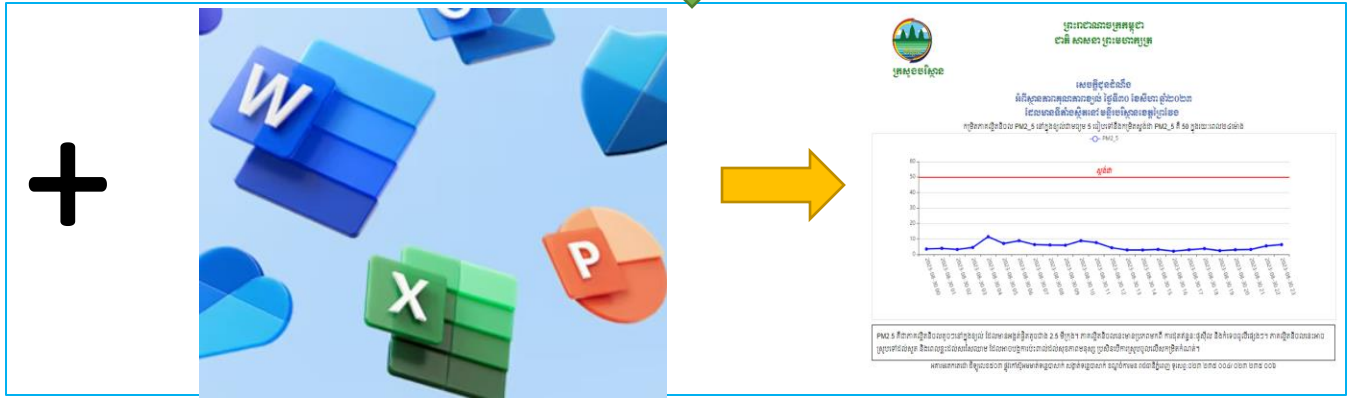




Data Processing

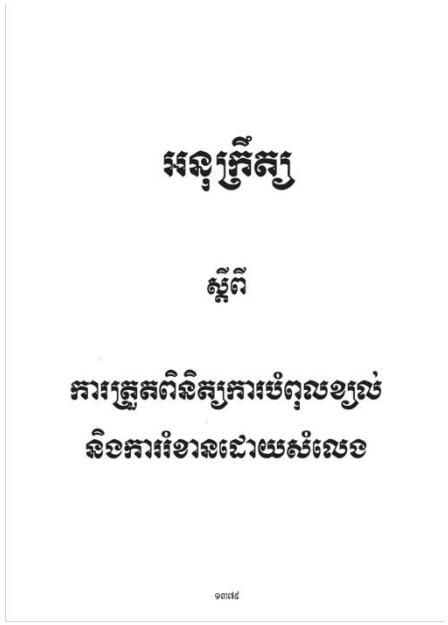








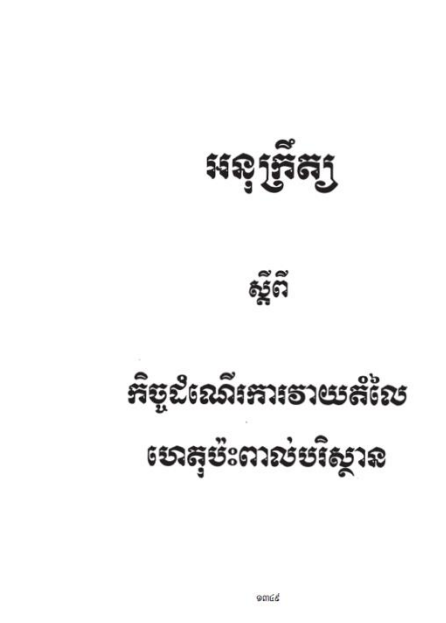
Policies and regulations


អនុក្រឹត្យ

ស្តីពី

ការត្រួតពិនិត្យការបំពុលខ្យល់
និងការរំខានដោយសំលេង

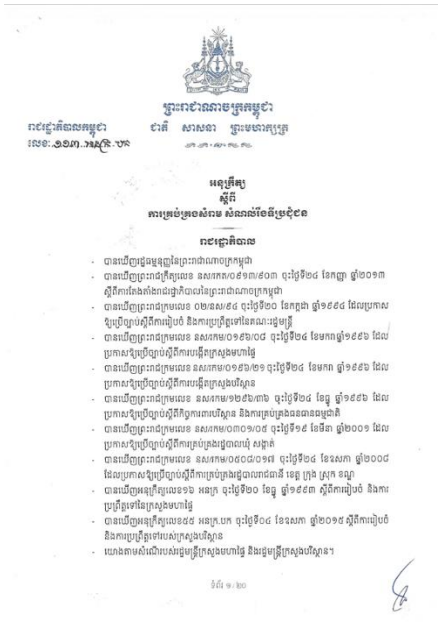
Sub Decree on Control of Air Pollution and Noise Disturbance, 2000


អនុក្រឹត្យ

ស្តីពី

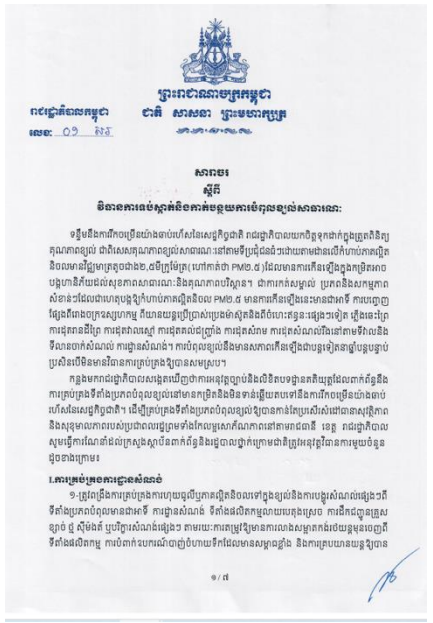
កិច្ចដំណើរការវាយតំលៃ
ហេតុប៉ះពាល់បរិស្ថាន

Sub Decree on Process of EIA, 1999


ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

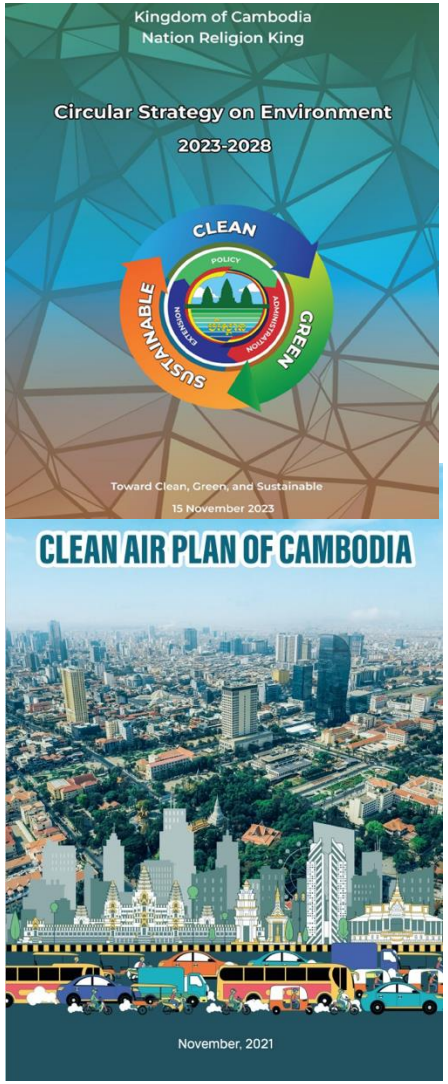
អនុក្រឹត្យ
ស្តីពី
ការគ្រប់គ្រងសំណល់រឹងពីឧស្សាហកម្ម

Sub Decree on Solid Waste Management, 1999


ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

សារាចរ
ស្តីពី
វិធានការទប់ស្កាត់និងកាត់បន្ថយការបំពុលខ្យល់សាធារណៈ

Circular on Measures on Air Pollution Prevention and Reduction , 2020



Sub Decree on Control of Air Pollution and Noise Disturbance, 2021

National Perspective

- What are the highest priority needs at the national and municipal level?
  - Install air quality equipment, data monitoring and forecasting center
  - Develop case study and evident base on cost of action and cost of inaction in air pollution
  - Develop policy instrument to mobile resources
- What similar projects have been recently undertaken?
  - Strengthening ASEAN Member States Policies with Environment Health Data on Cost of Inaction and Co-benefits – assessment report (human health related costs of not taking further action on air pollution are estimated to be equal to about 2.1% of Cambodia's Gross Domestic Product (GDP) in 2030)
  - Building the Pan-Asia Partnership for Geospatial Air Pollution Information- 1 Pandora and some training
- Are there opportunities for sustainability or harmonization?
  - Develop a regional project to strengthening air quality and health impact data collection
  - Mobilize resources from private sectors

Scientific Understanding

- Are there any specific areas which need to be studied in order to make informed policy choices?
  - Cost of action and cost of inaction in air pollution control on social and economic sectors. E.g case study and evident proof is essential

Financially Supporting Local Action

- What areas should be considered first for financial assistance?
  - Install air quality monitoring
  - Capacity building for air pollution control
  - Mobile resources for clean air actions

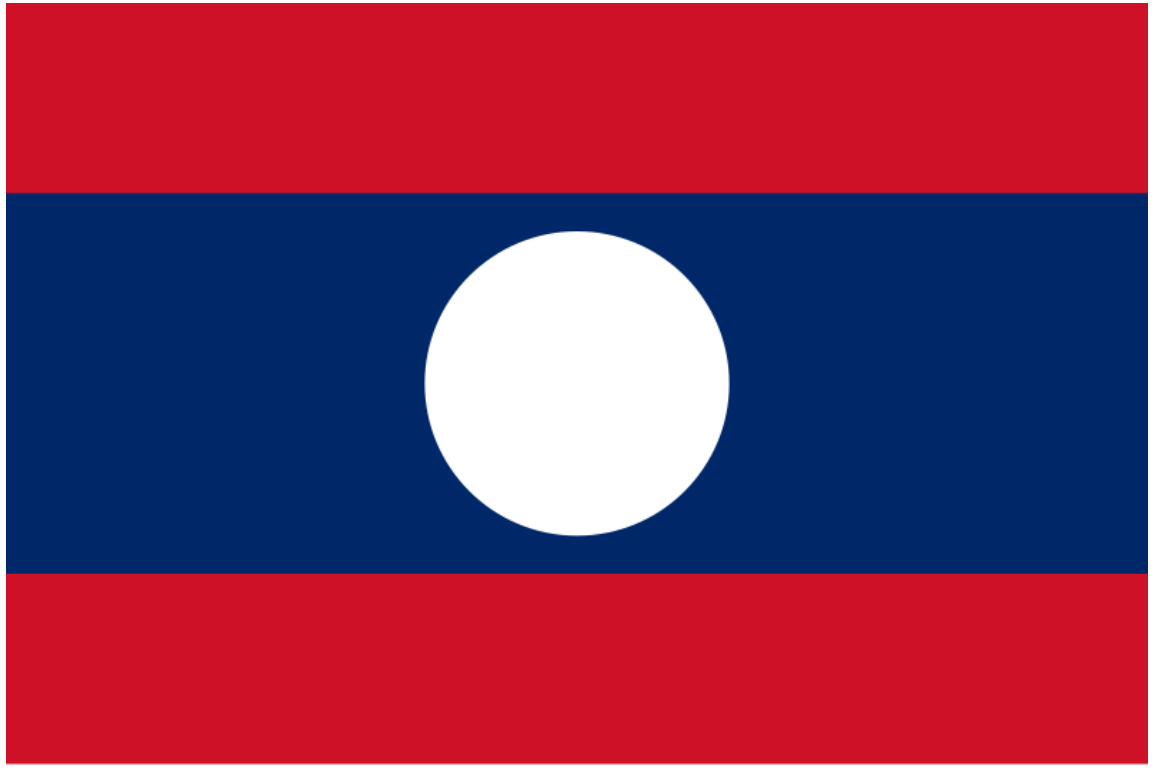
QUESTION AND ANSWER

UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

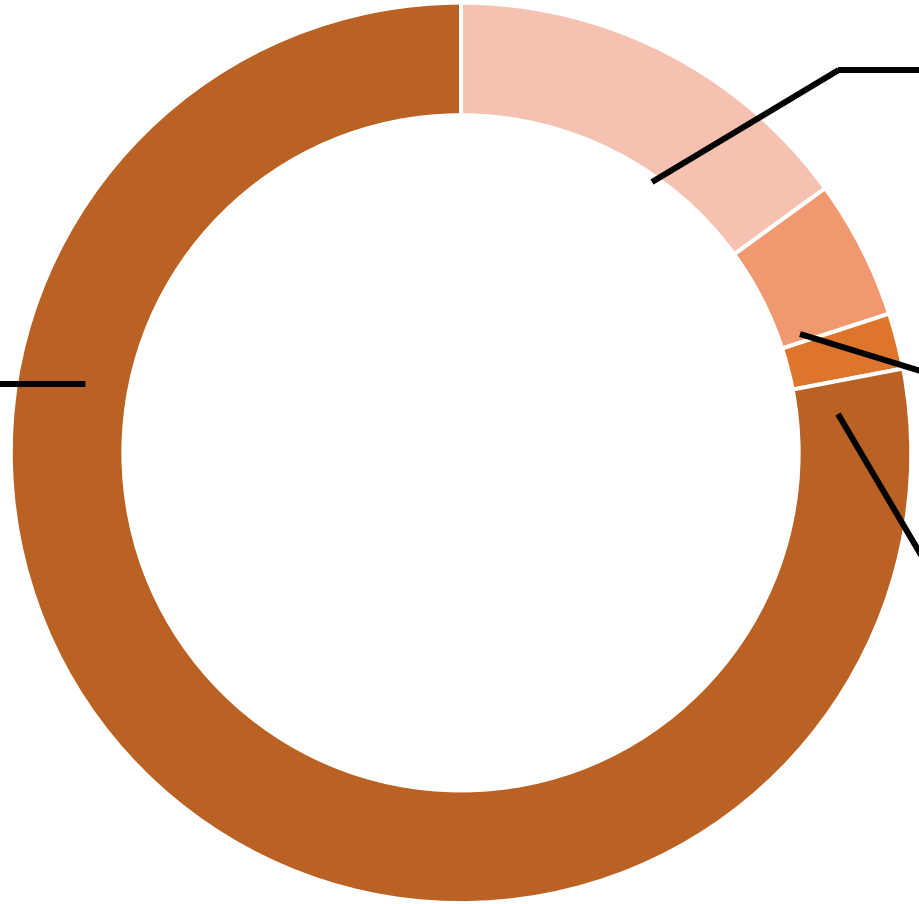


Lao PDR

- Scene Setting (ESCAP: 5 min)
- National Perspective (15 Min: Ministry/City) Needs, similar projects, sustainability and harmonization opportunities
- Questions & Answers(10 Min)



Main Sources of Air Pollution



78%
Agriculture

15%
Energy

5%
Industry

2%
Waste

Source: Ministry of Natural Resources and the Environment. 2020.

Household Air Pollution

1 Predominant Source

Household air pollution (HAP) is a predominant source of air pollution in Lao PDR, primarily due to the use of solid fuels for cooking and heating.

2 Biomass Fuel Use

Studies indicate a high prevalence of exposure to pollutants from cooking fires, with 78% of households using biomass fuels such as wood, charcoal, crop waste, and dung.

3 Indoor Air Quality

This form of pollution is particularly concerning because it directly affects indoor air quality and exposes residents to high levels of particulate matter and other harmful pollutants.

Agricultural and Forest Fires

1

Smoke Emissions

Outdoor air pollution in Lao PDR is significantly influenced by smoke from agricultural practices and forest fires.

2

Particulate Matter

These activities contribute to elevated levels of particulate matter and other pollutants in the atmosphere.

3

Key Source Sector

The emission inventory for Lao PDR highlighted forest fires as a key source sector for air pollutants, including particulate matter (PM2.5) and black carbon.



Proposed Action Areas



Data

Develop and/or adopt a platform for routine air pollution indicators



Agriculture

Provide alternative farming practices to reduce emissions



Enforcement

Fund staff and resources to enforce air quality standards across industries



Lao PDR National Presentation

Needs, similar projects, sustainability and harmonization opportunities

Discussion Session on Cooperation Priorities

Data Sharing

Communities of Practice



Harmonization with Similar Projects

Partnerships

Sustainability Opportunities

Evaluation: Regional Approaches to Reduce Pollution in Transboundary Airsheds: Inception



Thank you

Follow us:

unescap

unitednationsescap

united-nations-escap

unescap.org

ESCAP

Economic and Social Commission for Asia and the Pacific