

ASSESSING AIR POLLUTION REDUCTION IMPACT OF NATIONALLY DETERMINED CONTRIBUTIONS (NDC) IN VIET NAM

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1. Introduction

2. Air emission inventory and GHG for Hanoi city

3. Air emission inventory and GHG for Ho Chi Minh city

4. Conclusions

INTRODUCTION

HANOI

- 8.4357 mil habitants in 2022, 3.359,82 km²
- 6,091,986 motorcycles
- 686,755 cars
- ~ 2,000 factories having air emissions



Air in Hanoi and Ho Chi Minh cities are polluted in some hours and some pollutants

((<https://quanly.moitruongvadot hi.vn/6/27050/Canh-bao-Muc-do-o-nhiem-khong-khi-ky-luc-o-Ha-Noi-va-TPHCM.aspx>))



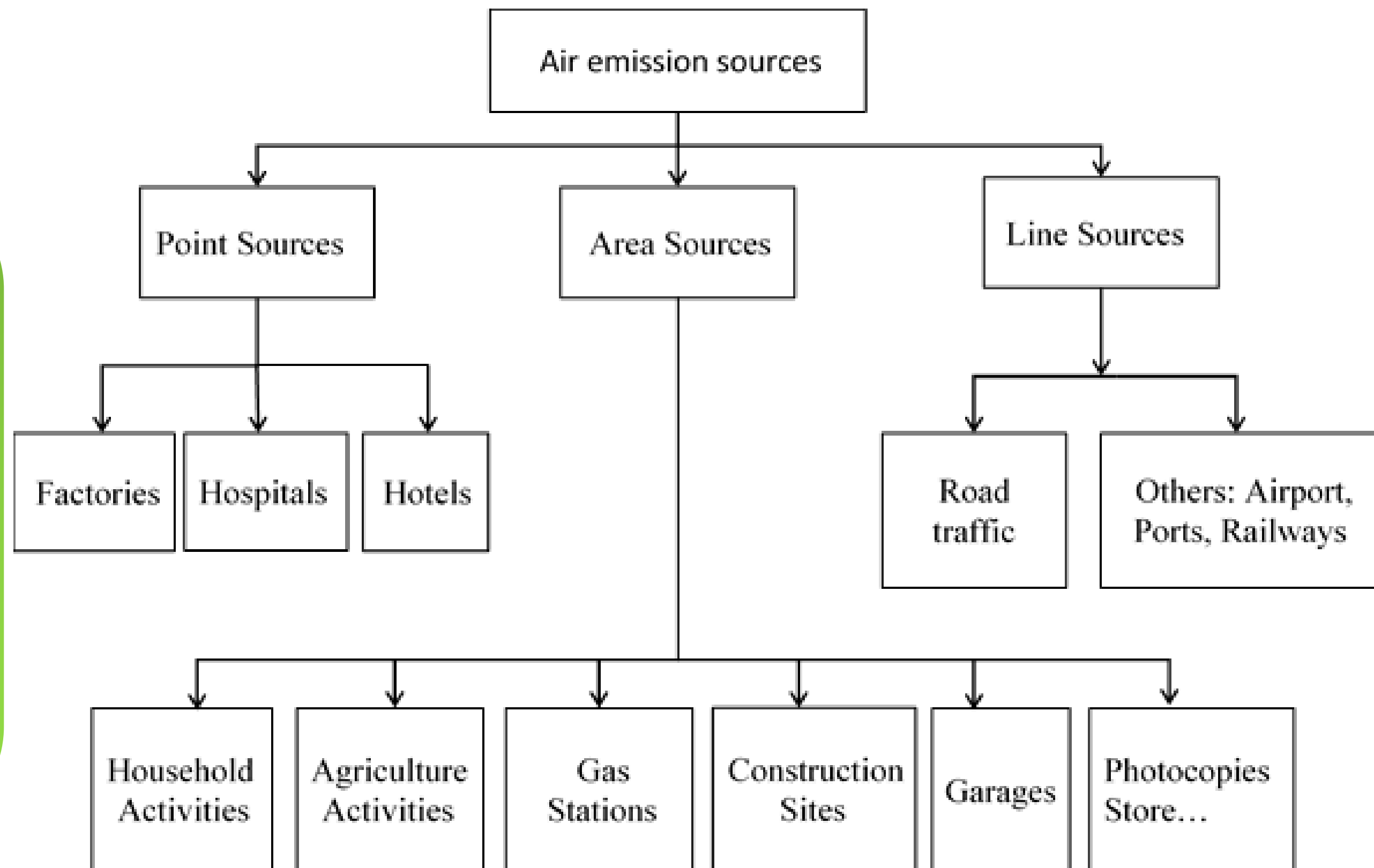
METHODS: SOURCE OF AIR POLLUTION:

❖ Methodology:

Combine Bottom up & Top down;
Emission factor

❖ Data sources

Survey, traffic count
General statistic office

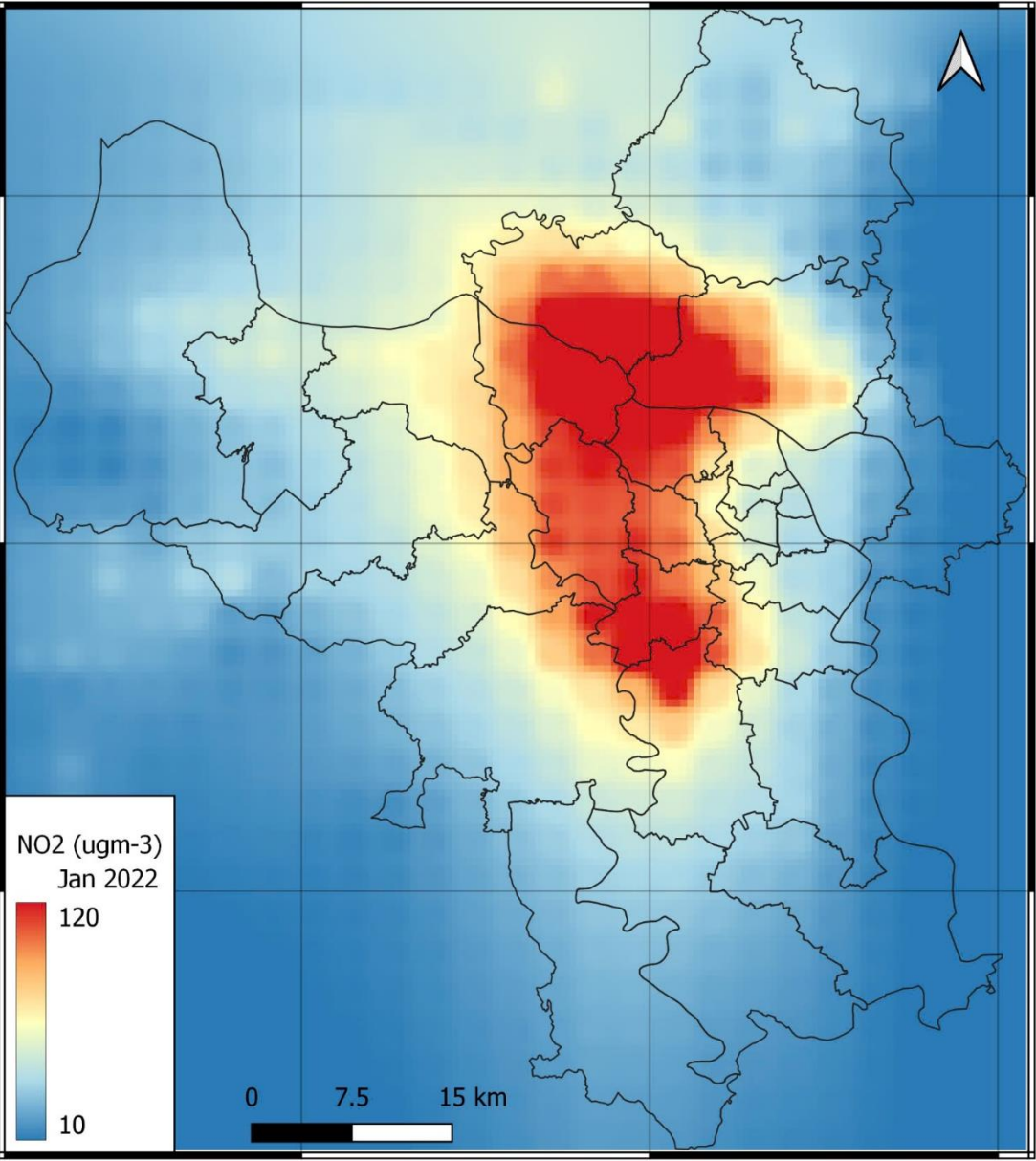
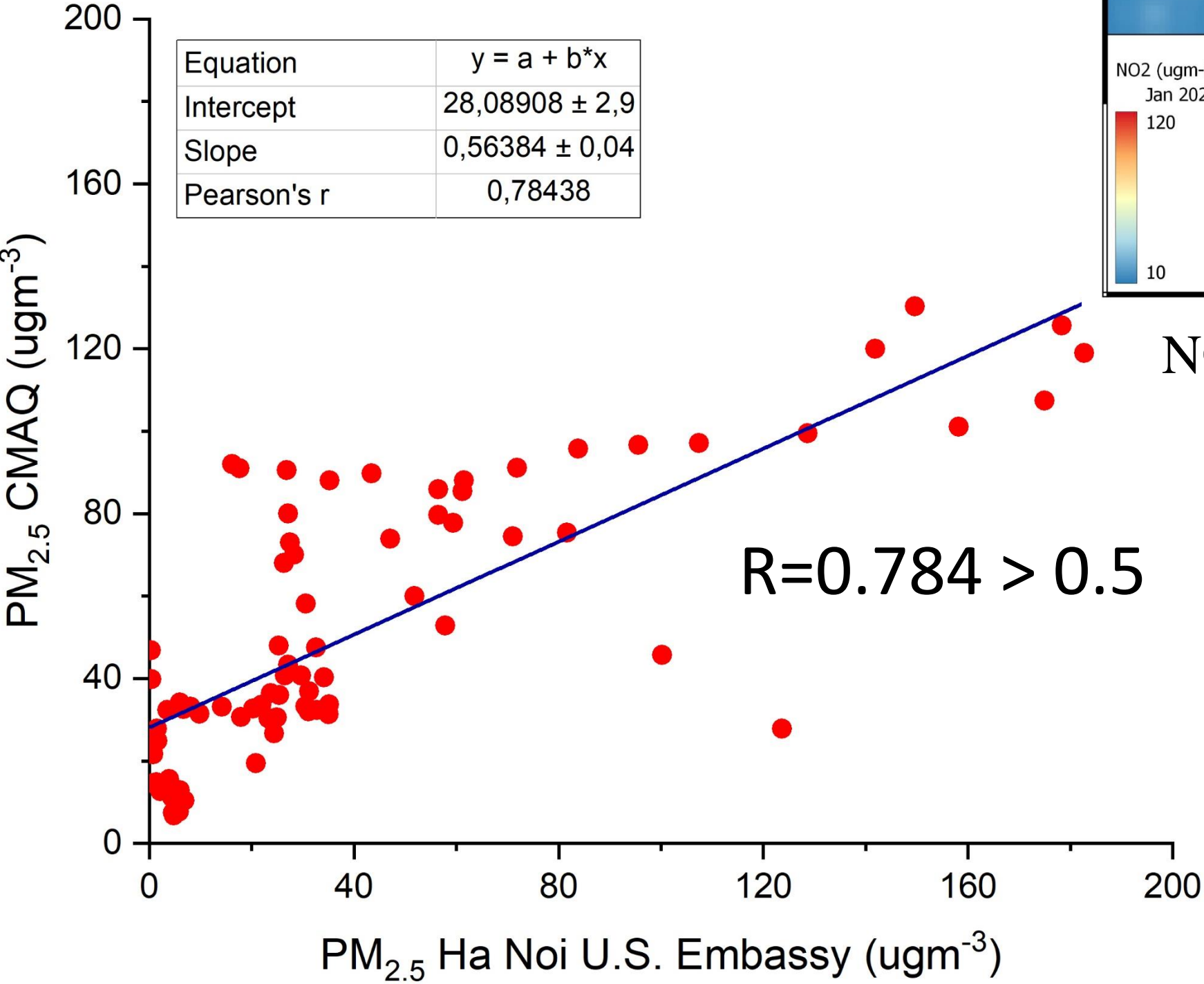


TOTAL EMISSIONS IN HANOI IN 2022

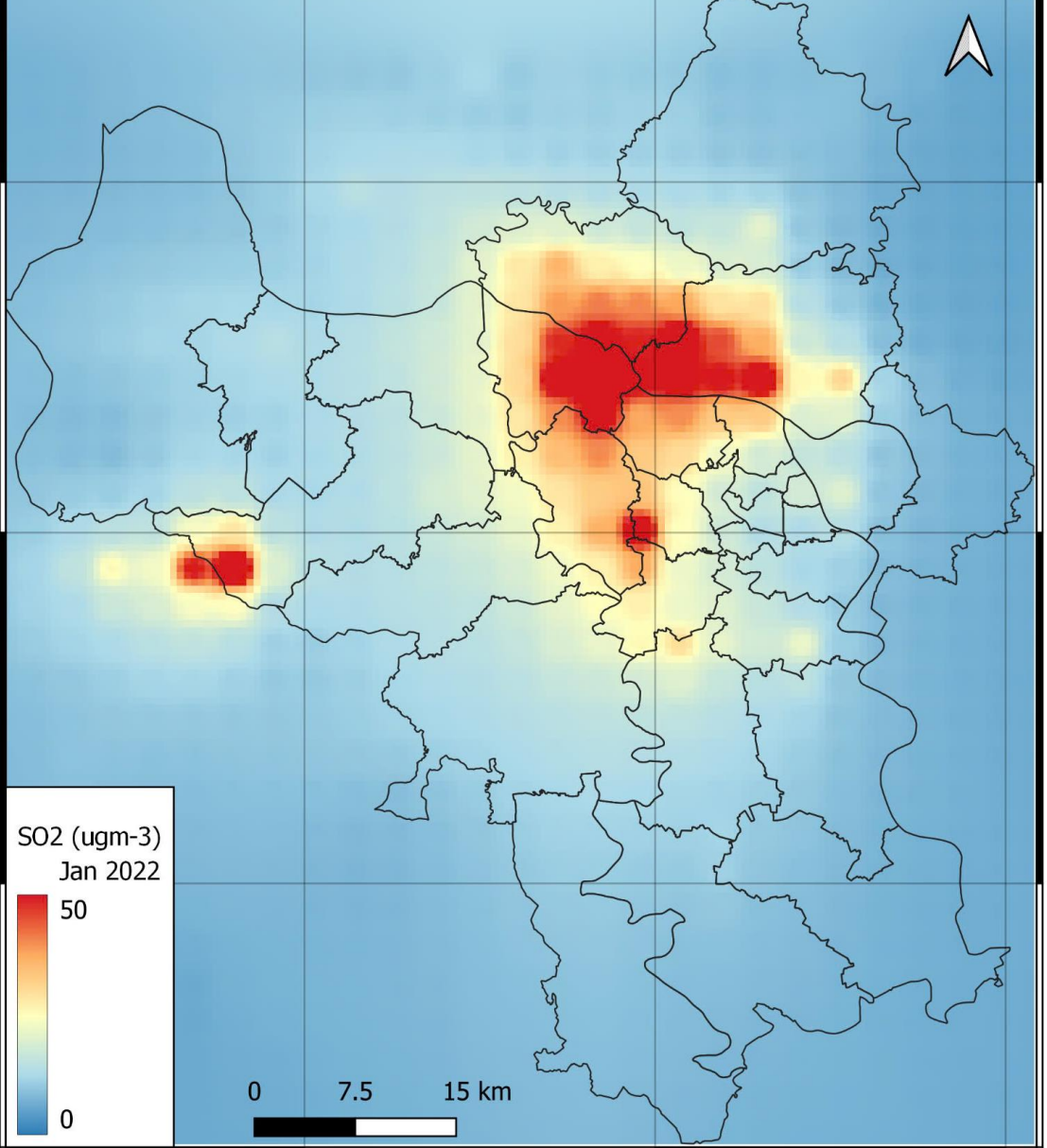
NO _x		CO		SO ₂	
Motorcycles	34.28%	Motorcycles	95.68%	Textiles	33.23%
Heavy truck	27.52%	Car	1.55%	Motorcycles	18.48%
Bus	19.50%	Biomass burning	0.61%	Car	12.71%
Automobile and motorbike manufacturing	2.03%	Households	0.43%	Chemicals	7.97%
PM _{2.5}		Biomass burning			5.50%
Heavy truck	39.73%	PM ₁₀			
Car	16.94%	Heavy truck			36.58%
Bus	11.90%	Car			15.50%
Biomass burning	10.93%	Biomass burning			13.37%
Motorcycles	4.50%	Bus			10.83%
Households	4.03%	Paper Manufacturing			5.35%

RESULTS OF AIR POLLUTION STIMULATION FOR HANOI

5 - 8, Jan 2022



NO2 monthly max 120 $\mu\text{g}/\text{m}^3$



SO2 monthly max 50 $\mu\text{g}/\text{m}^3$

I.QUANTIFYING THE ENVIRONMENTAL CO-BENEFIT IMPACT OF REDUCING AIR POLLUTION AND GREENHOUSE GASES OF INTRODUCTION: 10 INTER-DISTRICT VINBUS (ELECTRIC BUS) ROUTES

Context:

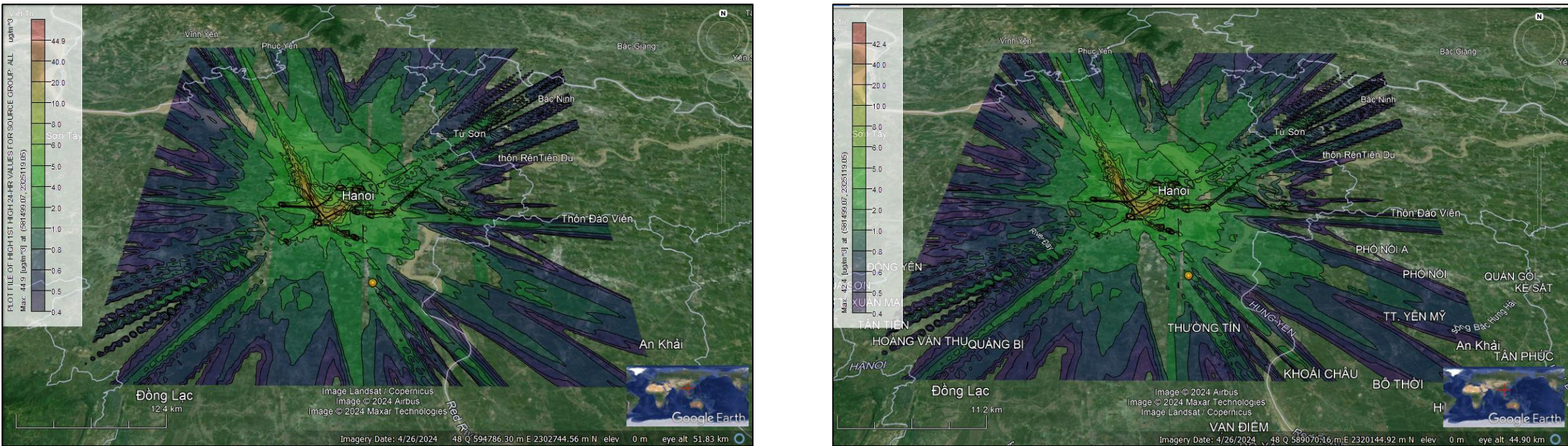
- "Assess the co-benefits of reducing emissions and greenhouse gases from the electric bus as a partial replacement for motorcycles, cars, and regular buses.
- Conduct a co-benefit assessment of 10 inter-district VinBus routes for the community.

Tuyến (Routes)	Lượng phát thải (tấn/năm) giảm từ hoạt động xe buýt điện (Emissions (tons/year) reduced from electric bus operations)							
	NMVOC	CO	SO ₂	NO _x	PM _{2.5}	CO ₂	CH ₄	N ₂ O
Phát thải giảm	-8,168.8	-15,307.1	-54.1	-595.6	-137.4	-268,344.8	-657.3	-3.8
% giảm	-7%	-7%	-6%	-3%	-4%	-7%	-9%	-6%

When 10 routes of VinBus electric buses are in operation, **air quality improves by approximately 5.5%**

- 5,57% SO₂ 24 hours average

Calculate the amount of GHG and emissions reduced when operating 10 VinBus electric bus routes in Hanoi."



II. QUANTIFYING THE ENVIRONMENTAL CO-BENEFIT IMPACT OF REDUCING AIR POLLUTION: REPLACING 50% OF FOSSIL FUEL-POWERED BUSES BY ELECTRIC BUSES FOR WHOLE HANOI

- ❖ Scenario 1: The current situation in 2022.
- ❖ Scenario 2: When the transportation sector implements emission reduction measures:
replacing 50% of fossil fuel-powered buses by electric buses for whole Hanoi

Table: The reduction is calculated by the difference in **average daily concentration** ($\mu\text{g}/\text{m}^3$) between the two scenarios @ two stations

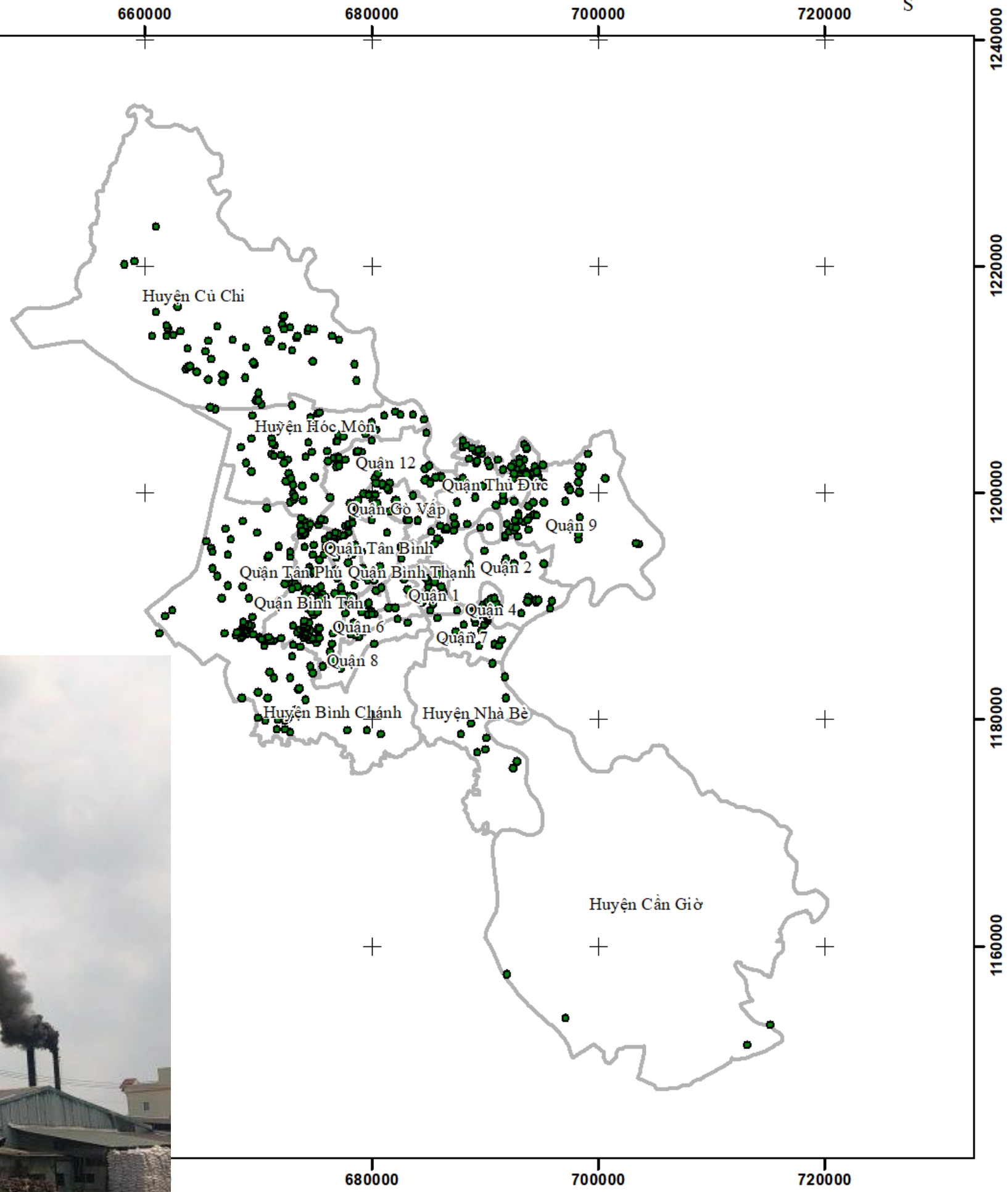
Preliminary results

Reduction concentration (%)	CO	SO ₂	NO ₂	O ₃	PM _{2.5}	PM ₁₀
Trung Yen station	0.01	0.04	3.01	-0.74	0.05	-0.01
Minh Khai station	0.01	0.07	3.04	-0.70	0.04	-0.01

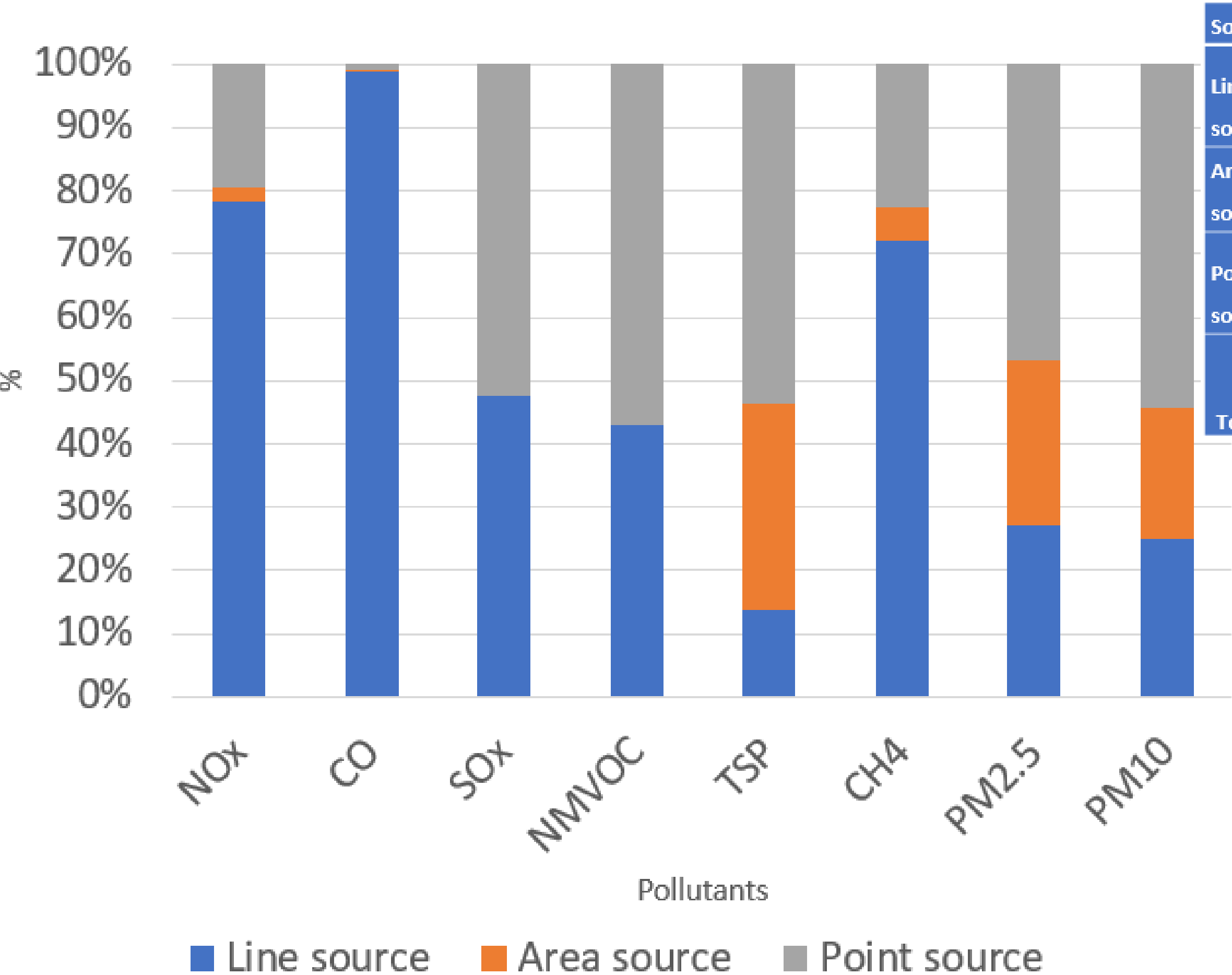
- NO₂ showed the most significant reduction due to its primary emissions source being traffic
- O₃ increased in Scenario 2 due to photochemical reaction mechanisms

INTRODUCTION: HO CHI MINH CITY

- 9.389 mil habitants in 2022, 2090km²
- 7,339,522 motorcycles
- 637,323 cars
- 2708 factories having air emissions



SOURCE OF AIR POLLUTION IN HO CHI MINH CITY



Sources	NOx	CO	SOx	NMVOC	TSP	CH4	PM2.5	PM10
Line source	47,048	3,499,354	10,115	585,506	2,883	10,215	1,873	2,398
Area source	1,388	12,007	32	1,680	6,770	737	1,805	2,004
Point source	11,699	30,726	11,122	777,050	11,133	3,218	3,252	5,227
Total	60,135	3,542,087	21,269	1,364,236	20,786	14,170	6,930	9,629

- ✓ Traffic sources: 78.2 %, 98.8%, 47.6%, and 72.1% of NOx, CO, SO₂, and CH₄.
- ✓ Industry: 52.3%, 57%, 53.6%, 46.9% and 54.3% of the total SO₂, NMVOC, TSP, PM_{2.5} and PM₁₀.
- ✓ The area sources: 32.6% of TSP and 26% of PM_{2.5} and 20.8% of PM₁₀

QUANTIFYING THE CO-BENEFITS OF AIR POLLUTION AND GREENHOUSE GASES OF MODAL SHIFT FOR THE METRO LINE 1, HO CHI MINH CITY

Context:

- Metro line 1 will replace Motorcycles, car, buses in road parallel with Metro line 1
- Assessment of air quality (e.g. emissions reductions of PM, NOx, etc.) and GHG reduction for Metro line 1 HCMC



Total CO_{2eq} emission reduction by Metro Line 1 (ton/year)

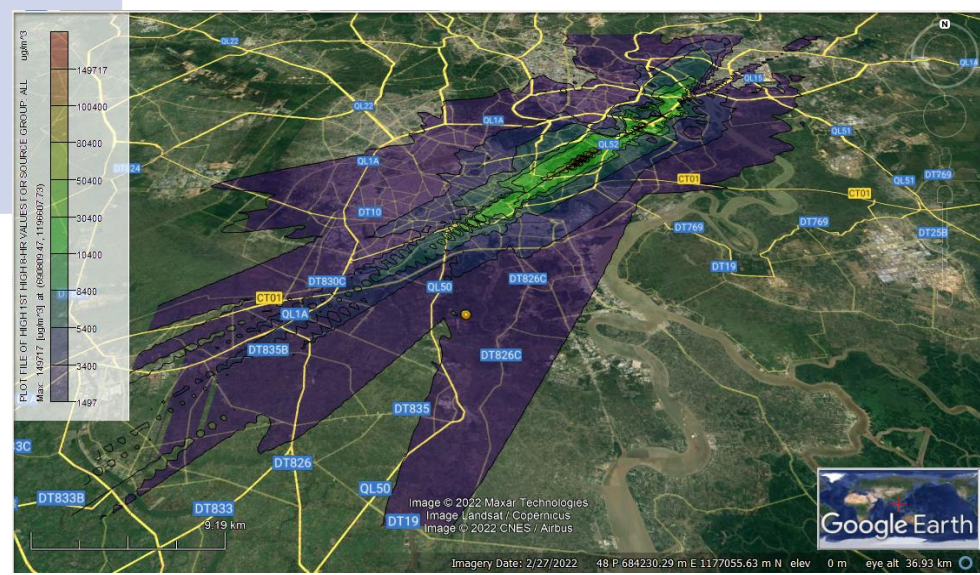
Emission reduction on the parallel route by Metro Line 1 operation

Greenhouse gases reductions (ton/year)	CO ₂	N ₂ O	CH ₄
Emissions (tons/year) (electric consumption)	42,946 ^a		
Conversion factor to GWP (CO _{2eq})	1	298	28
Emissions load CO _{2eq} (ton/year)	-3,306.800	-331.009	-45,990.00
Total emission reductions CO _{2eq} (ton/year)	-49'627		

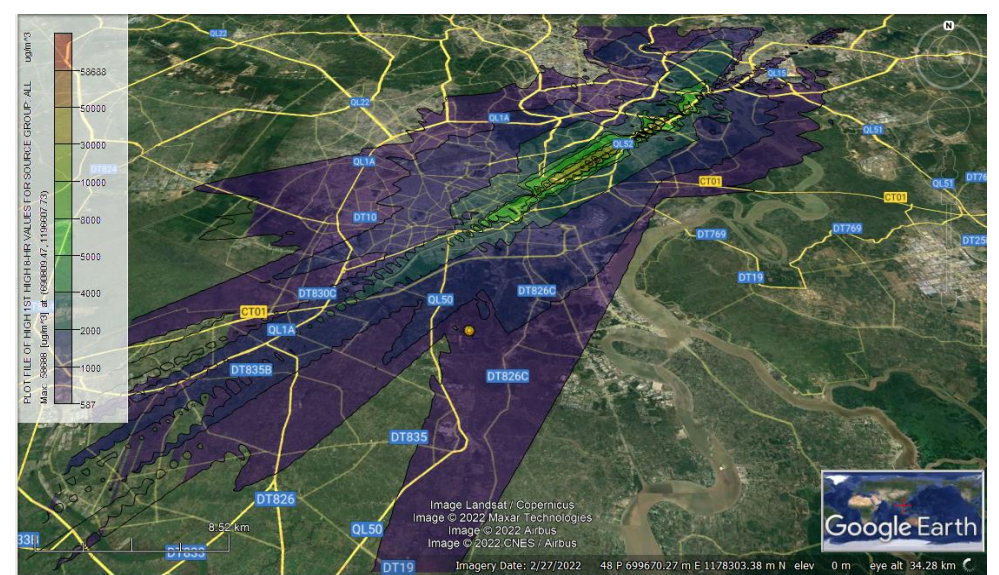
Pollutants	NO _x	CO	SO ₂	NMVOC	PM _{2.5}
reduction (ton/year)	-429.94	-13,639.32	-11.36	-1,137.84	-24.27
reduction rate (%)	-44.86	-60.40	-31.41	-56.94	-16.23

Air quality (CO, SO₂, NMVOC, NOx and PM_{2.5}) improved significantly, especially alongside the roads of the Metro line; and total emission reductions 49'627 ton CO_{2eq} /year

Baseline



Metro line 1 operation

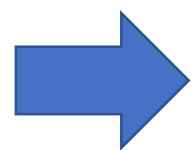


- 60%

The highest 8-hour average concentration of CO

CONCLUSIONS

- ❖ A combination of bottom-up and top-down approaches was employed to conduct air pollution EI, in which **EMISENS model** was utilized to generate the EI for road traffic sources.
- ❖ **For Hanoi**, traffic sources accounted for the largest emissions; the traffic source accounted for 87%, 92%, 57%, 86%, 96% and 74% of NO_x , CO, SO_2 , NMVOC, CH₄ and $\text{PM}_{2.5}$; industrial activities contributed 39% of the SO_2 total emissions of Hanoi; the area sources accounted for 33% of TSP and 14% of $\text{PM}_{2.5}$ and 17% of PM_{10} .
- ❖ **For HCMC**: The results showed that the **motorcycles** were the main reasons of emission, contributing 97.8% of CO, 42.9% of non-methane volatile organic compounds (NMVOC), 71.8% of CH₄, 37.7% of SO_2 , and 69.2% of NO_x and 18% of particulate matter ($\text{PM}_{2.5}$).
- ❖ Assessing impact of reduction measure: For “metro line 1 HCMC”, Air quality such as CO, SO_2 , NMVOC, NO_x and $\text{PM}_{2.5}$ improved significantly, especially alongside the roads of the Metro line; and total emission reductions 49,627 ton CO₂eq /year



NET-ZERO PLAN FOR HANOI AND HCMC?

Thank you very much!



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