هفتمین نشست منطقه ای مجمع جهانی سلامت

7th World Health Summit Regional Meeting

Tehran University of Medical Sciences

KISH ISLAND, I.R. IRAN | 29-30 April 2019

Overview of air pollution in Iran: the case of Tehran

Vahid Hosseini, PhD.

- Associate Prof. of Mechanical Eng., Sharif University
- Head of national committee on air pollution reduction plans, Department of Environment of I.R.Iran

General trends

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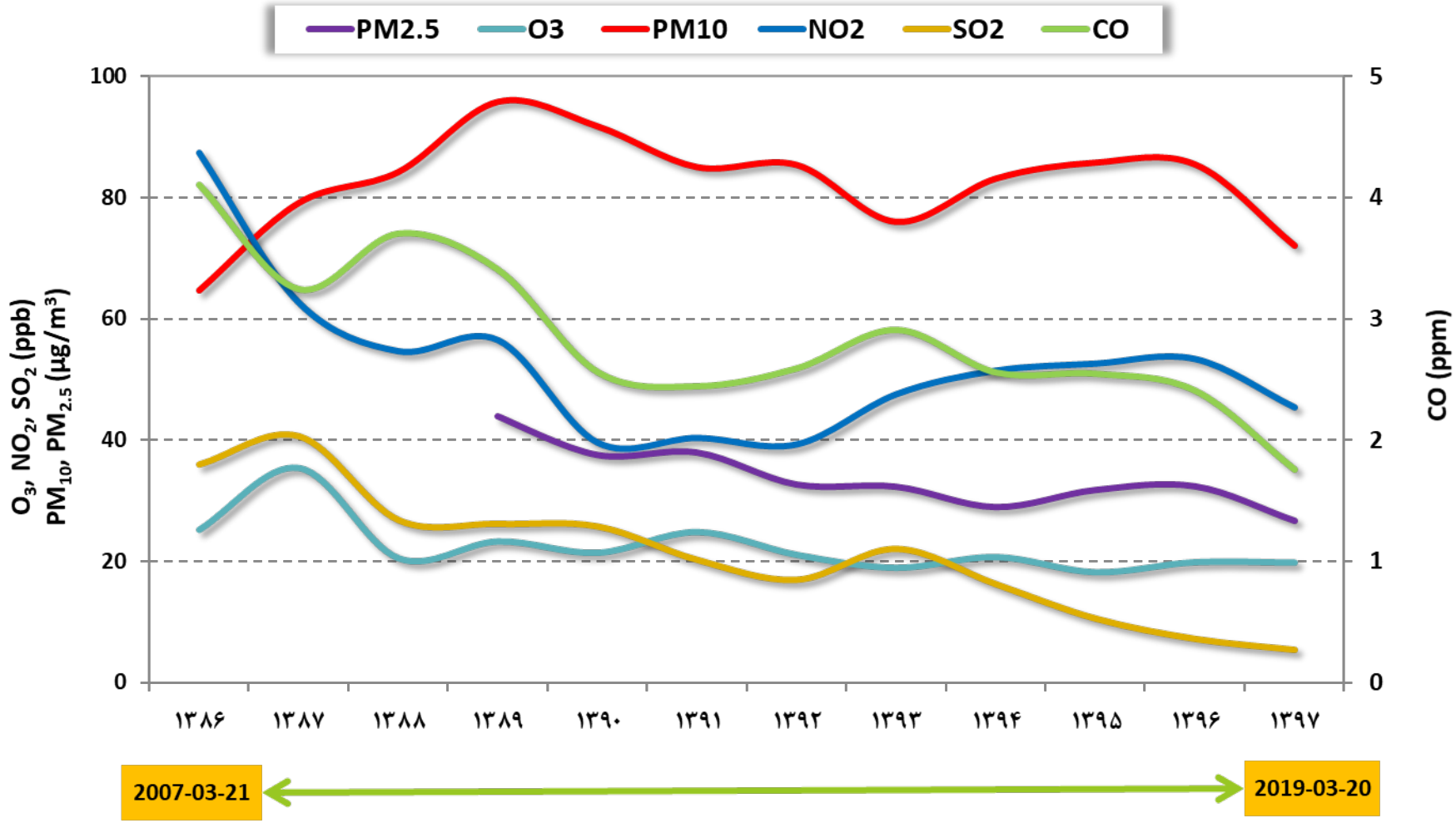
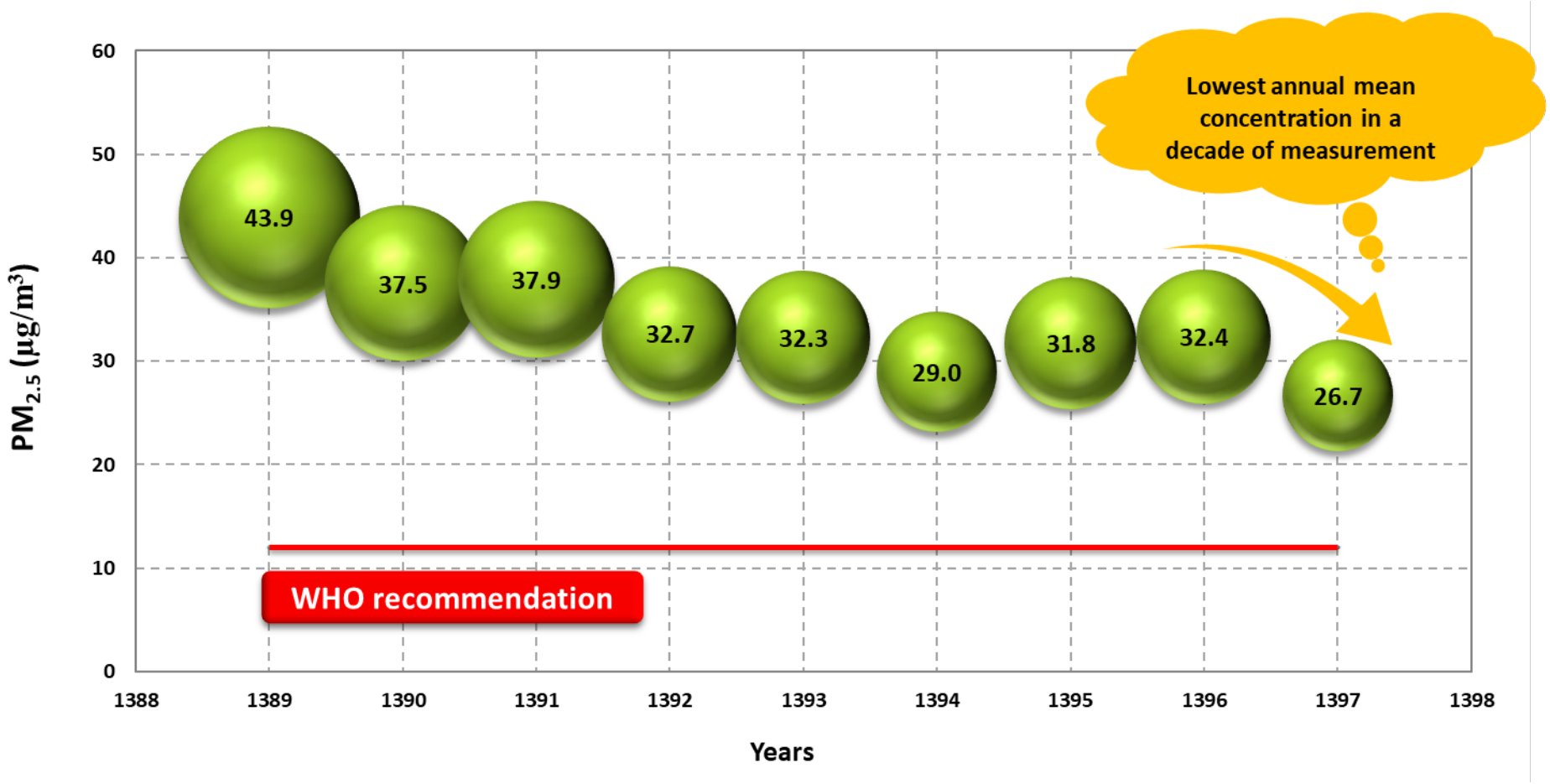
Annual mean of various air pollutants, Tehran, 2007-2019



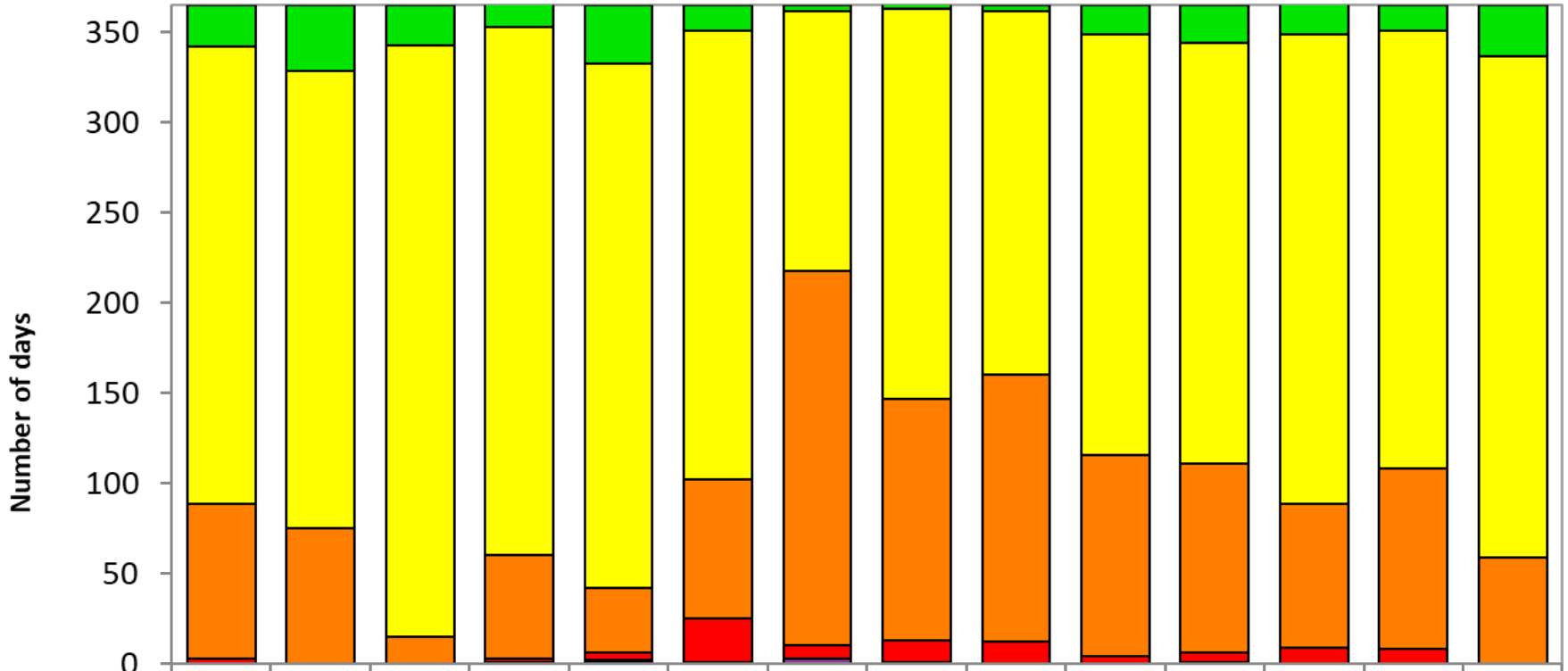
Data and graphs by Tehran Air Quality Control Co. (AQCC), http://air.Tehran.ir

PM2.5, the criteria pollutant, Tehran, 2011-2019



Data and graphs by Tehran Air Quality Control Co. (AQCC), http://air.Tehran.ir

Number of healthy/unhealthy days according to AQI, 2006-2019

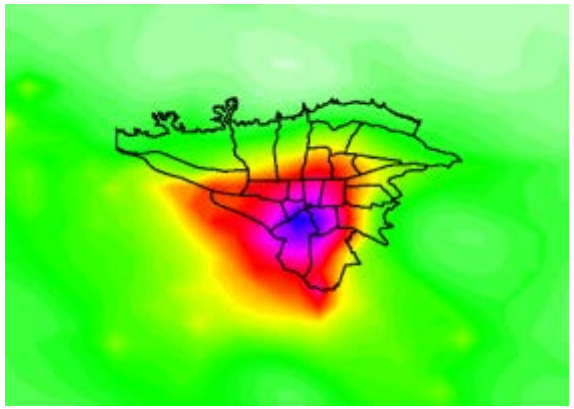


	1384	1385	1386	1387	1388	1389	1390	1391	1392	1393	1394	1395	1396	1397
Good	23	36	22	13	32	14	3	3	3	16	21	17	14	28
Healthy	253	254	328	293	291	249	144	216	202	233	233	260	243	278
Unhealthy for sensitive groups	86	75	15	57	36	77	208	134	148	112	105	80	100	59
Unhealthy	3	0	0	2	4	24	7	12	12	4	5	9	8	0
Very Unhealthy	0	0	0	1	1	1	3	1	0	0	1	0	0	0
Hazardous	0	0	0	0	1	0	0	0	0	0	0	0	0	0

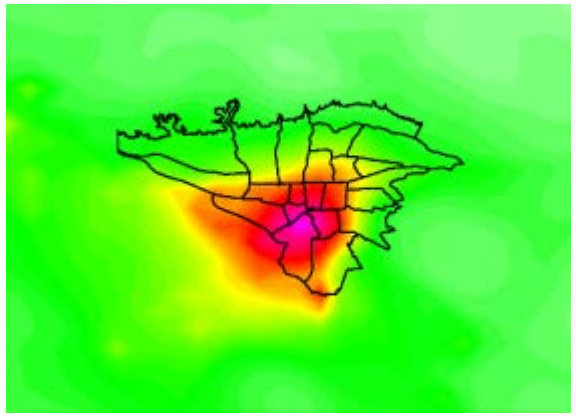
Data and graphs by Tehran Air Quality Control Co. (AQCC), http://air.Tehran.ir

The reality of winter air pollution, dependency on atmospheric stability

PM2.5 monthly average concentration, Tehran, 2016



Nov



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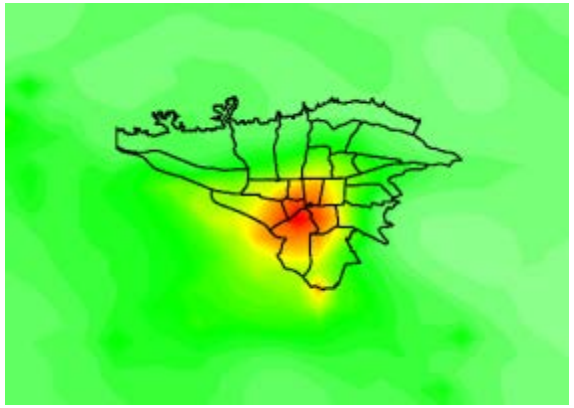

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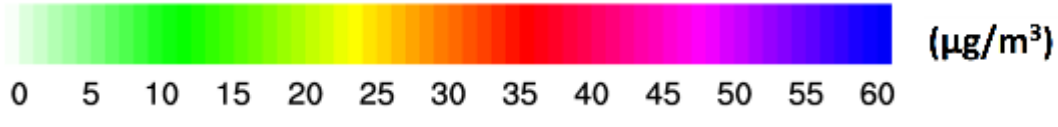

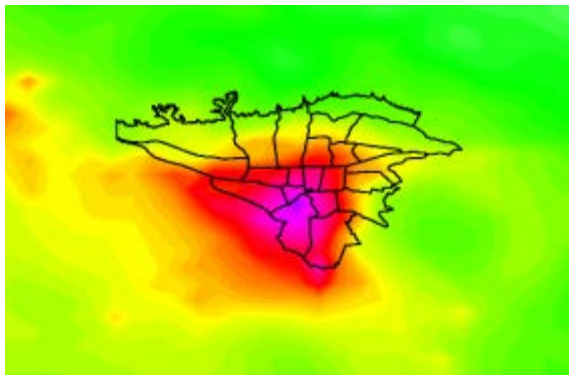

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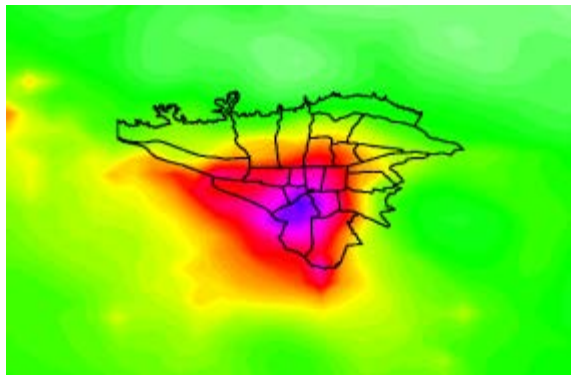
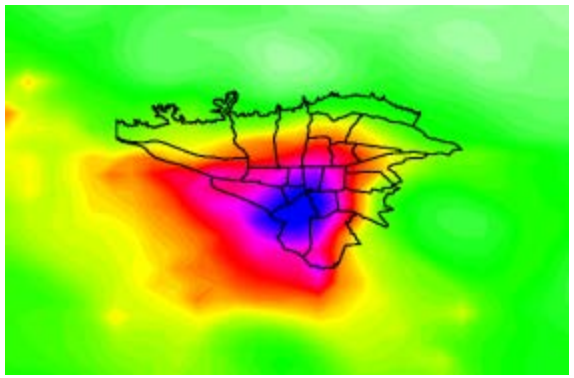


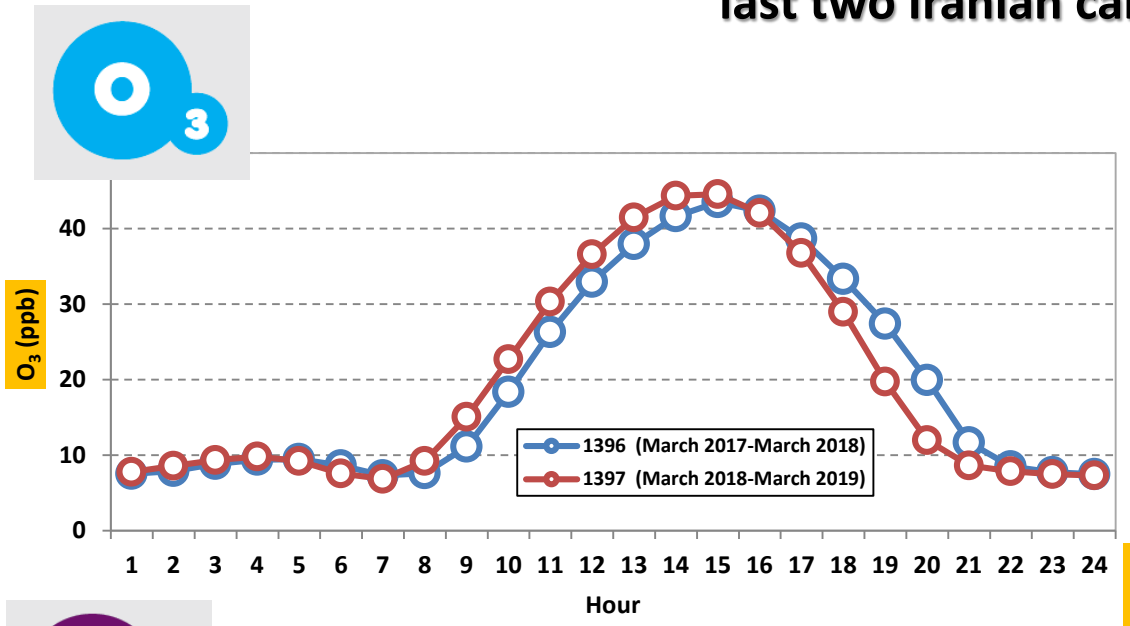
Jan

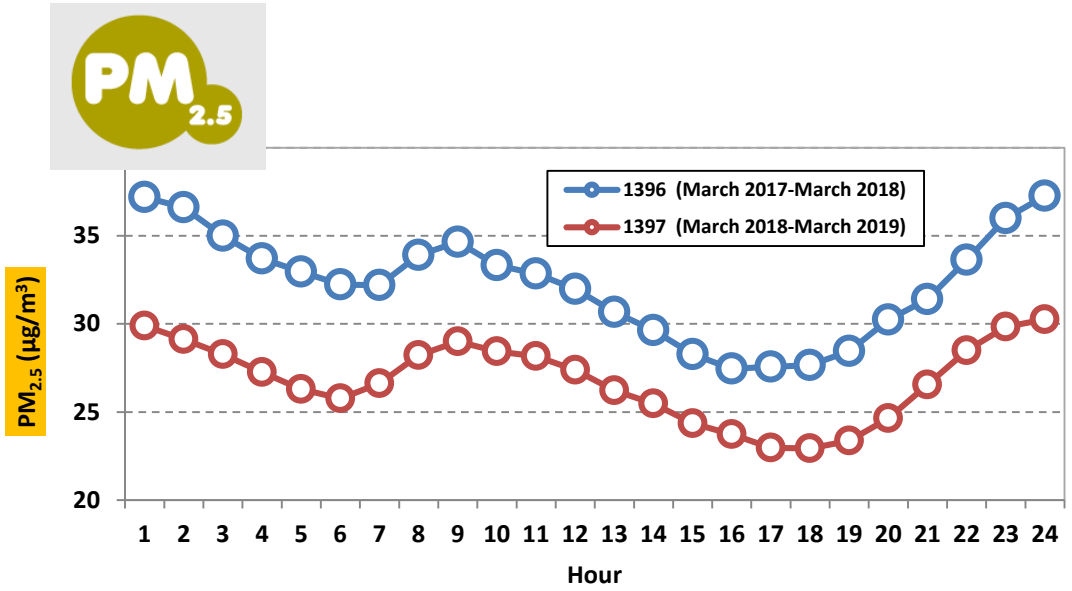


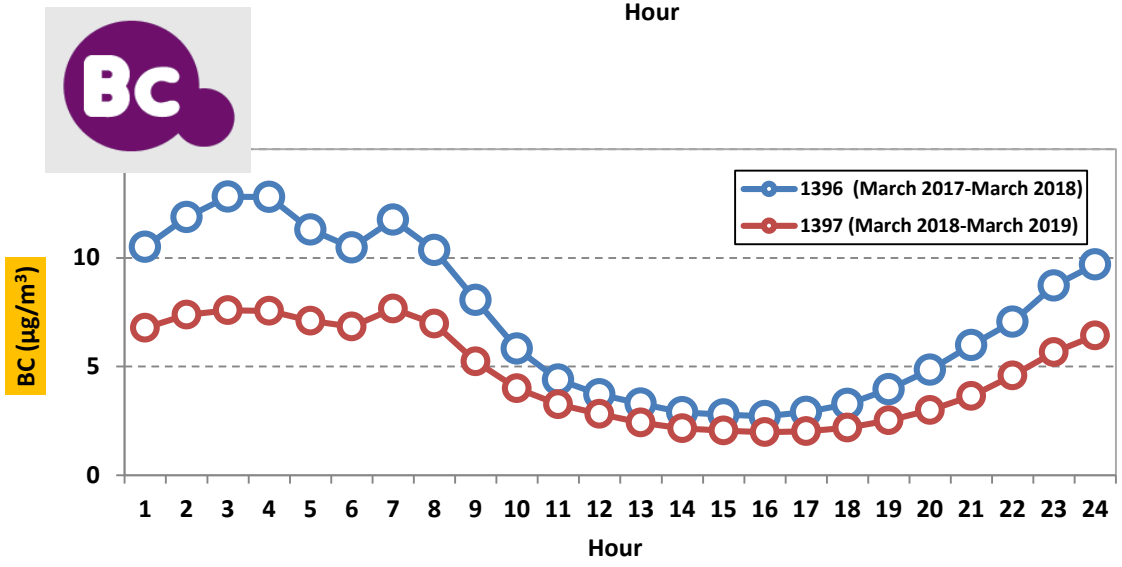
Dec

Data and graphs by Tehran Air Quality Control Co. (AQCC), http://air.Tehran.ir

Comparison of O3, PM2.5, and BC mean concentration for cold seasons of the last two Iranian calendar years







Data and graphs by Tehran Air Quality Control Co. (AQCC), http://air.Tehran.ir

Tehran air pollution in international literature

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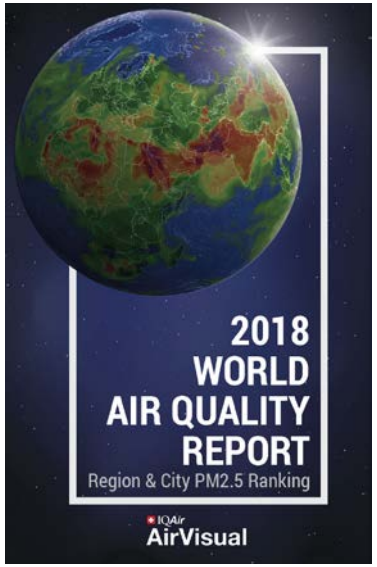
World country/region ranking

Sorted by estimated average PM2.5 concentration (µg/m³)

1	Bangladesh	97.1
2	Pakistan	74.3
3	India	72.5
4	Afghanistan	61.8
5	Bahrain	59.8
6	Mongolia	58.5
7	Kuwait	56.0
8	Nepal	54.2
9	United Arab Emirates	49.9
10	Nigeria	44.8
11	Indonesia	42.0
12	China Mainland	41.2
13	Uganda	40.8
14	Bosnia & Herzegovina	40.0
15	Macedonia	35.5
16	Uzbekistan	34.3
17	Vietnam	32.9
18	Sri Lanka	32.0
19	Kosovo	30.4
20	Kazakhstan	29.8
21	Peru	28.0
22	Ethiopia	27.1
23	Thailand	26.4
24	Bulgaria	25.8
25	Iran	25.0
26	Chile	24.9
27	South Korea	24.0
28	Serbia	23.9
29	Poland	22.4
30	Croatia	22.2
31	Turkey	21.9
32	Macau	21.2
33	Mexico	20.3
34	Czech Republic	20.2
35	Hong Kong	20.2
36	Cambodia	20.1
37	Romania	18.6
38	Israel	18.6
39	Taiwan	18.5
40	Slovakia	18.5
41	Cyprus	17.6
42	Lithuania	17.5
43	Hungary	16.8
44	Brazil	16.3
45	Austria	15.0
46	Italy	14.9
47	Singapore	14.8
48	Philippines	14.6
49	Ukraine	14.0
50	Colombia	13.9
51	Puerto Rico	13.7
52	Belgium	13.5
53	France	13.2
54	Germany	13.0
55	Japan	12.0
56	Netherlands	11.7
57	Switzerland	11.6
58	Russia	11.4
59	Luxembourg	11.2
60	Malta	11.0
61	United Kingdom	10.8
62	Spain	10.3
63	Ireland	9.5
64	Portugal	9.4
65	USA	9.0
66	Canada	7.9
67	New Zealand	7.7
68	Norway	7.6
69	Sweden	7.4
70	Estonia	7.2
71	Australia	6.8
72	Finland	6.6
73	Iceland	5.0

Based on PM2.5 annual average, Iran is 25th most polluted country among 73



World regional capital city ranking

Sorted by average yearly PM2.5 concentration (µg/m³)

1. Delhi, India (113.5)
2. Dhaka, Bangladesh (97.1)
3. Kabul, Afghanistan (61.8)
4. Manama, Bahrain (59.8)
5. Ulaanbaatar, Mongolia (58.5)
6. Kuwait City, Kuwait (56.0)
7. Kathmandu, Nepal (54.4)
8. Beijing, China Mainland (50.9)
9. Abu Dhabi, UAE (48.8)
10. Jakarta, Indonesia (45.3)
11. Kampala, Uganda (40.8)
12. Hanoi, Vietnam (40.8)
13. Islamabad, Pakistan (38.6)
14. Sarajevo, Bosnia & Herzegovina (38.4)
15. Tashkent, Uzbekistan (34.3)
16. Skopje, Macedonia (34.0)
17. Colombo, Sri Lanka (32.0)
18. Pristina, Kosovo (30.4)
19. Astana, Kazakhstan (29.8)
20. Santiago, Chile (29.4)
21. Sofia, Bulgaria (28.2)
22. Lima, Peru (28.0)
23. Tehran, Iran (26.1)
24. Bangkok, Thailand (25.2)
25. Warsaw, Poland (24.2)
26. Belgrade, Serbia (23.9)
27. Seoul, South Korea (23.3)
28. Bucharest, Romania (20.3)
29. Phnom Penh, Cambodia (20.1)
30. Mexico City, Mexico (19.7)
31. Ankara, Turkey (19.6)

0 10 20 30 40 50 60 70 80 90 100 110

WHO PM2.5 Target

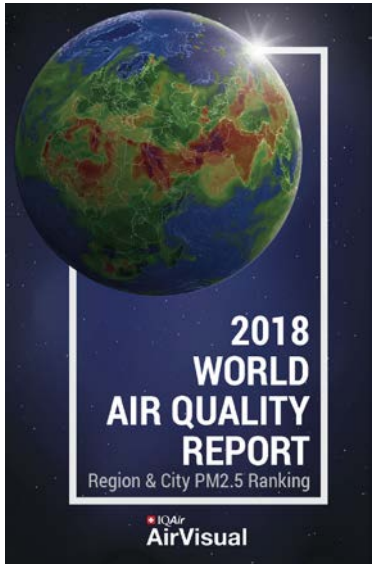
[Continued]

32. Tel Aviv-Yafo, Israel (19.5)
33. Vilnius, Lithuania (18.2)
34. Cyprus, Nicosia (17.4)
35. Prague, Czech Republic (17.4)
36. Bratislava, Slovakia (17.2)
37. Budapest, Hungary (16.5)
38. Paris, France (15.6)
39. Vienna, Austria (15.2)
40. Taipei, Taiwan (14.9)
41. Singapore, Singapore (14.8)
42. Manila, Philippines (14.3)
43. Brussels, Belgium (14.1)
44. Bogota, Colombia (13.9)
45. Kyiv, Ukraine (13.8)
46. Tokyo, Japan (13.1)
47. Bern, Switzerland (12.8)
48. London, UK (12.0)
49. Berlin, Germany (11.7)
50. Amsterdam, Netherlands (11.5)
51. Luxembourg City, Luxembourg (11.2)
52. Lisbon, Portugal (10.2)
53. Moscow, Russia (10.1)
54. Madrid, Spain (9.9)
55. Dublin, Ireland (9.5)
56. Washington DC, USA (9.2)
57. Oslo, Norway (8.2)
58. Helsinki, Finland (7.2)
59. Tallinn, Estonia (7.1)
60. Stockholm, Sweden (6.6)
61. Ottawa, Canada (6.0)
62. Wellington, New Zealand (6.0)

0 10 20 30 40 50 60 70

WHO PM2.5 Target

Based on PM2.5 annual average, Tehran is 23rd most polluted capital city among 62.



Economic and health cost of Tehran air pollution

The economic costs associated with air pollution in Tehran are estimated at USD 2.6 billion per year. Mortality and morbidity due to current level of air pollution in Tehran are estimated to cost the city's economy about USD $2.6 billion per annum (see Box 1 for detailed calculations). This estimate only considers human health effects, and therefore underestimates the total economic cost from air pollution. The total economic damage from air pollution would be much higher if one accounted for other impacts such as:

- reduced agricultural productivity;
- reduced visibility;
- long-term damage to cultural sites and infrastructure;
- reduced quality of life; and
- education-days lost because of closed schools.

Emissions

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Emission inventory approach – source contributions

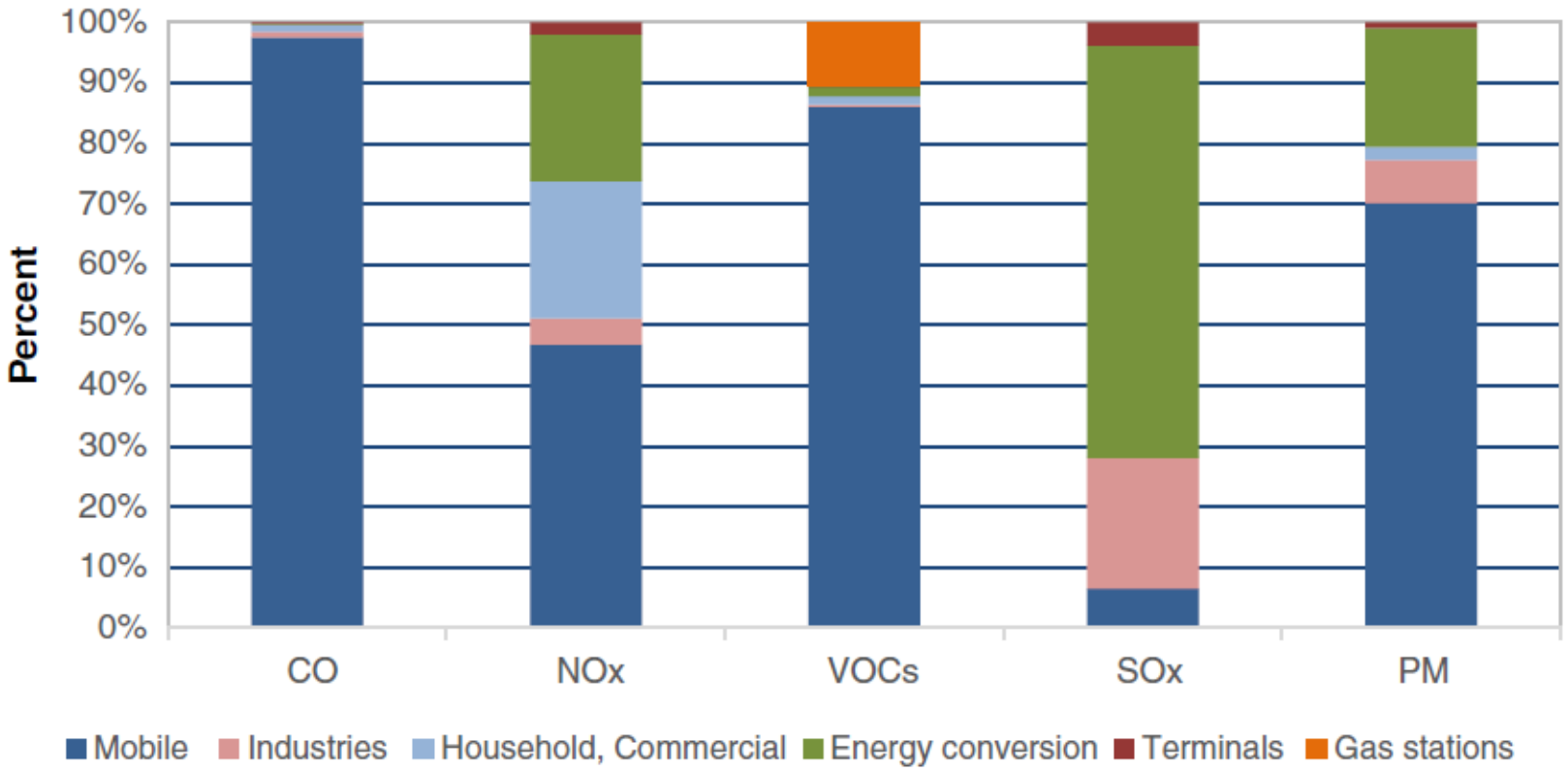


Fig. 3. Sectoral contributions to air pollution emission in Tehran for the base year of 2013.

Emission inventory approach – source contributions

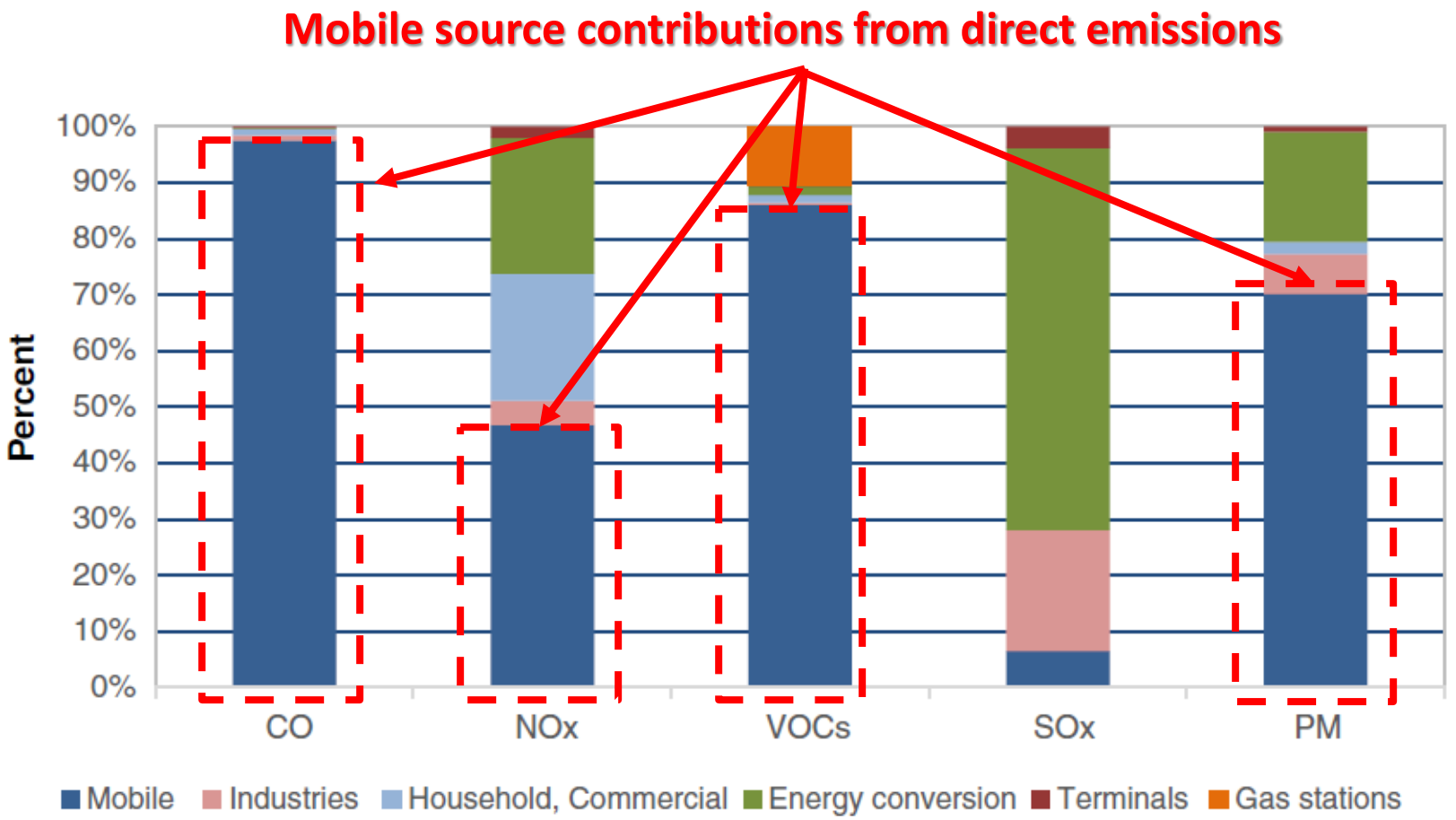
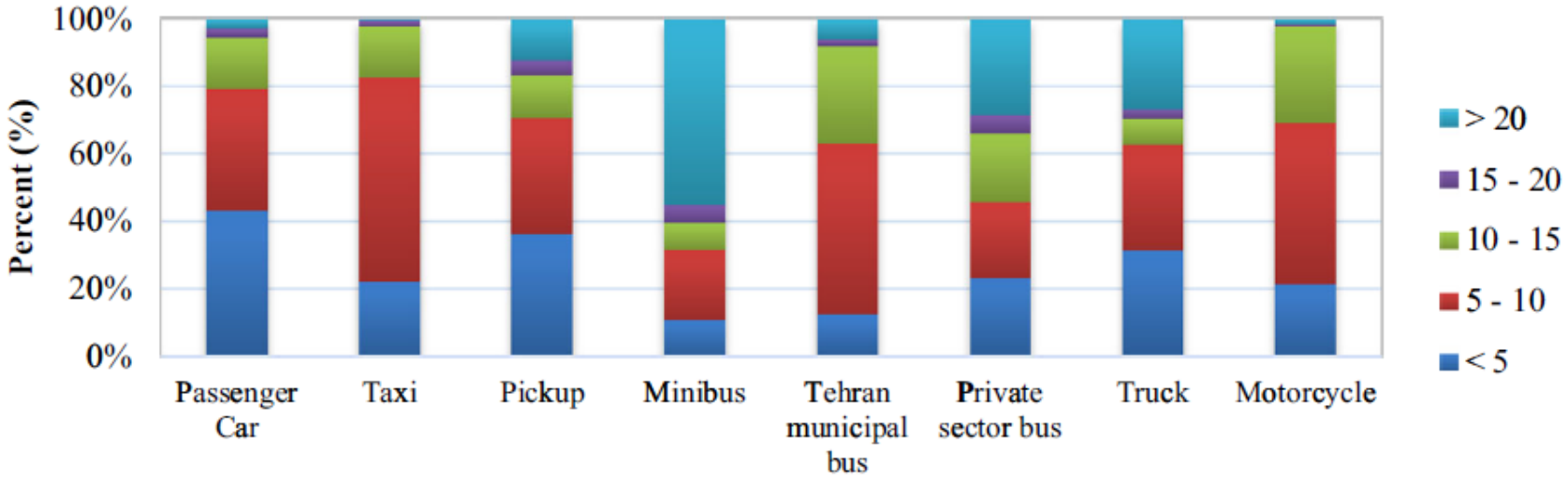
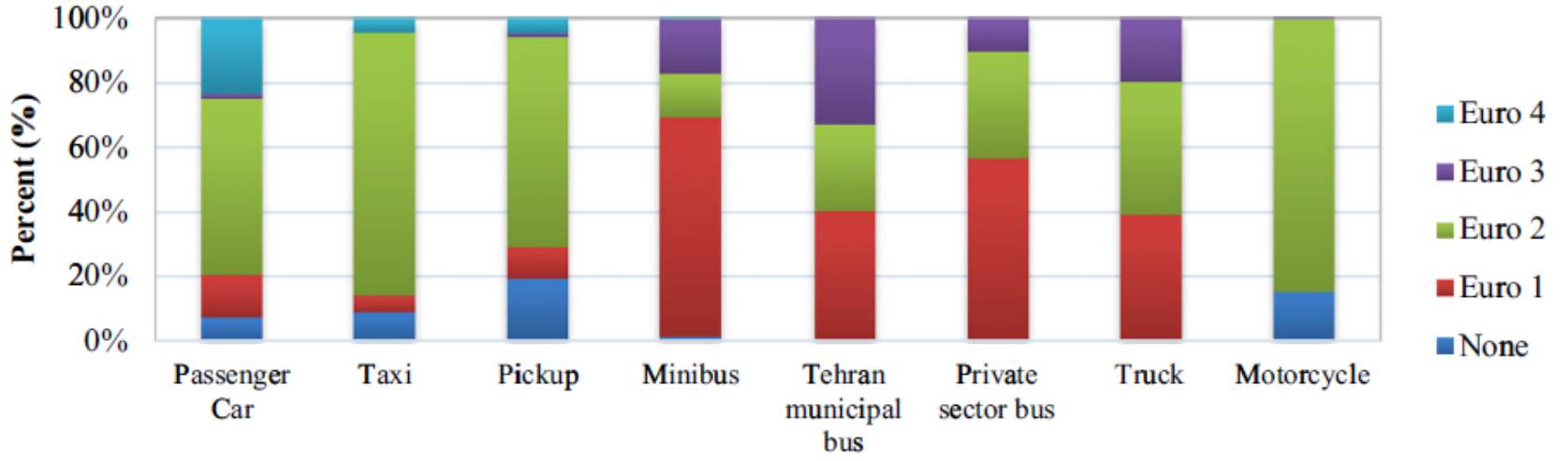


Fig. 3. Sectoral contributions to air pollution emission in Tehran for the base year of 2013.

Looking at Tehran fleet age and emission standards

(Based on Police license plate registration data, 1392 (2013))





Emiss. Control Sci. Technol. (2016) 2:44–56

Looking at Tehran fleet age and emission standards

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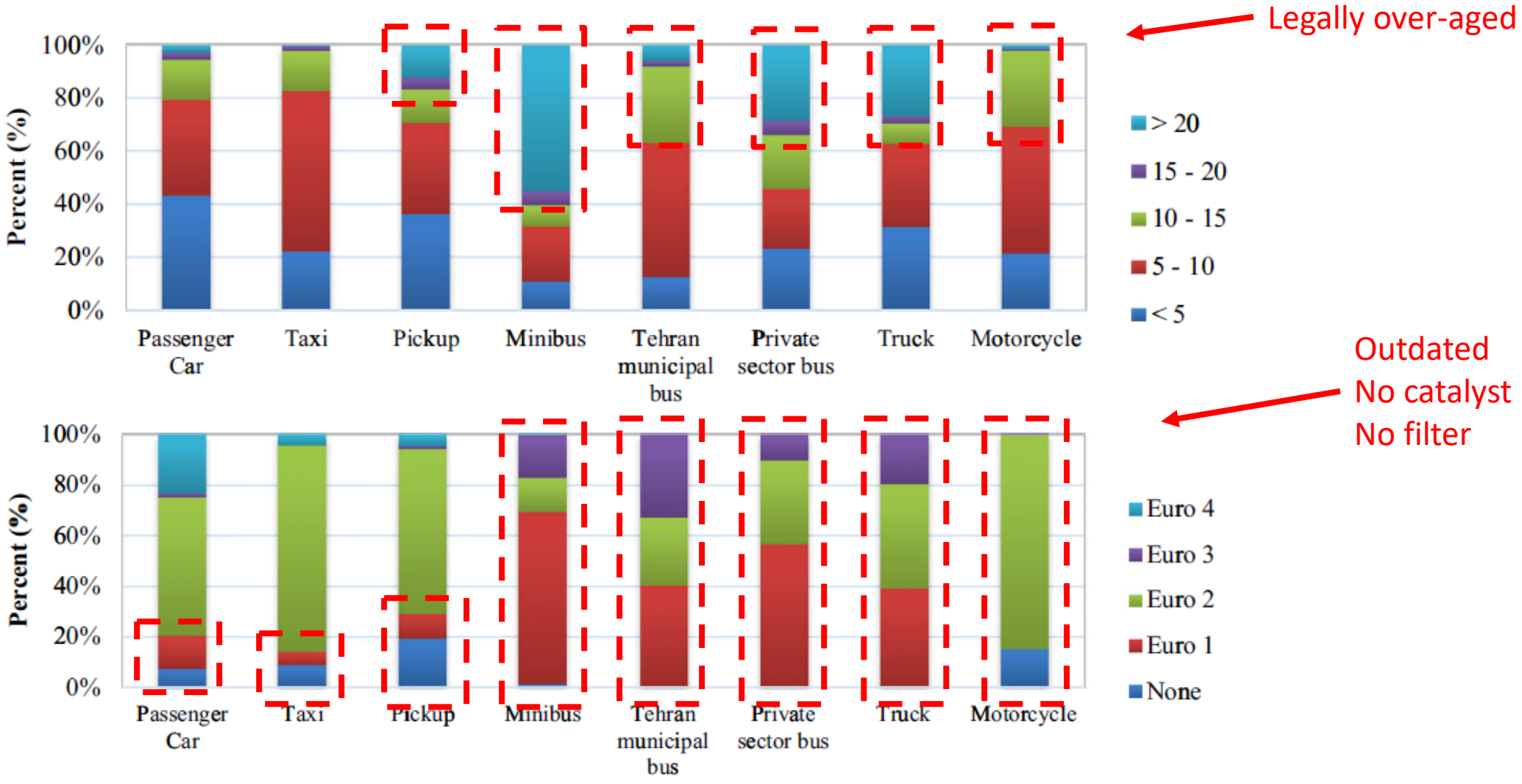
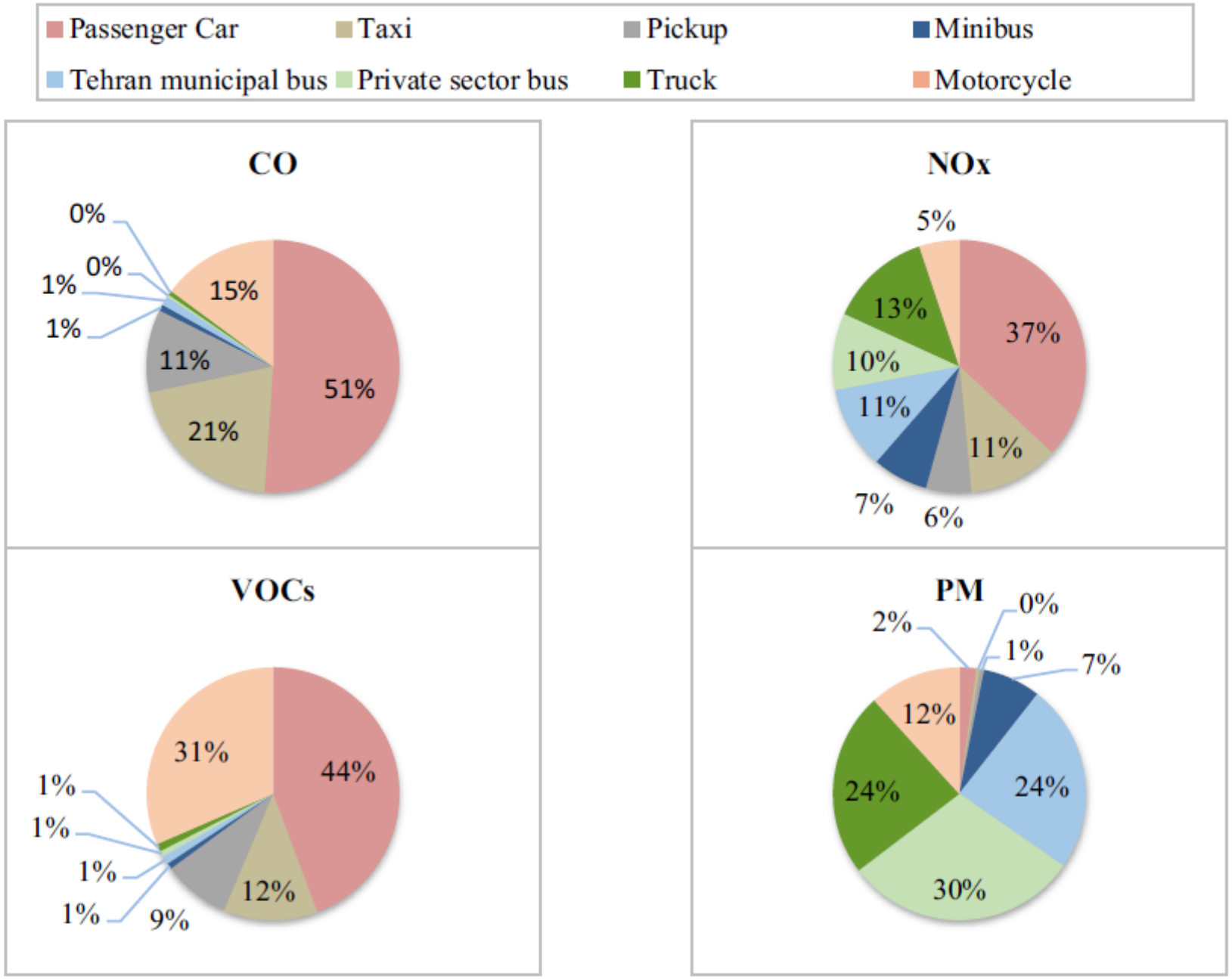


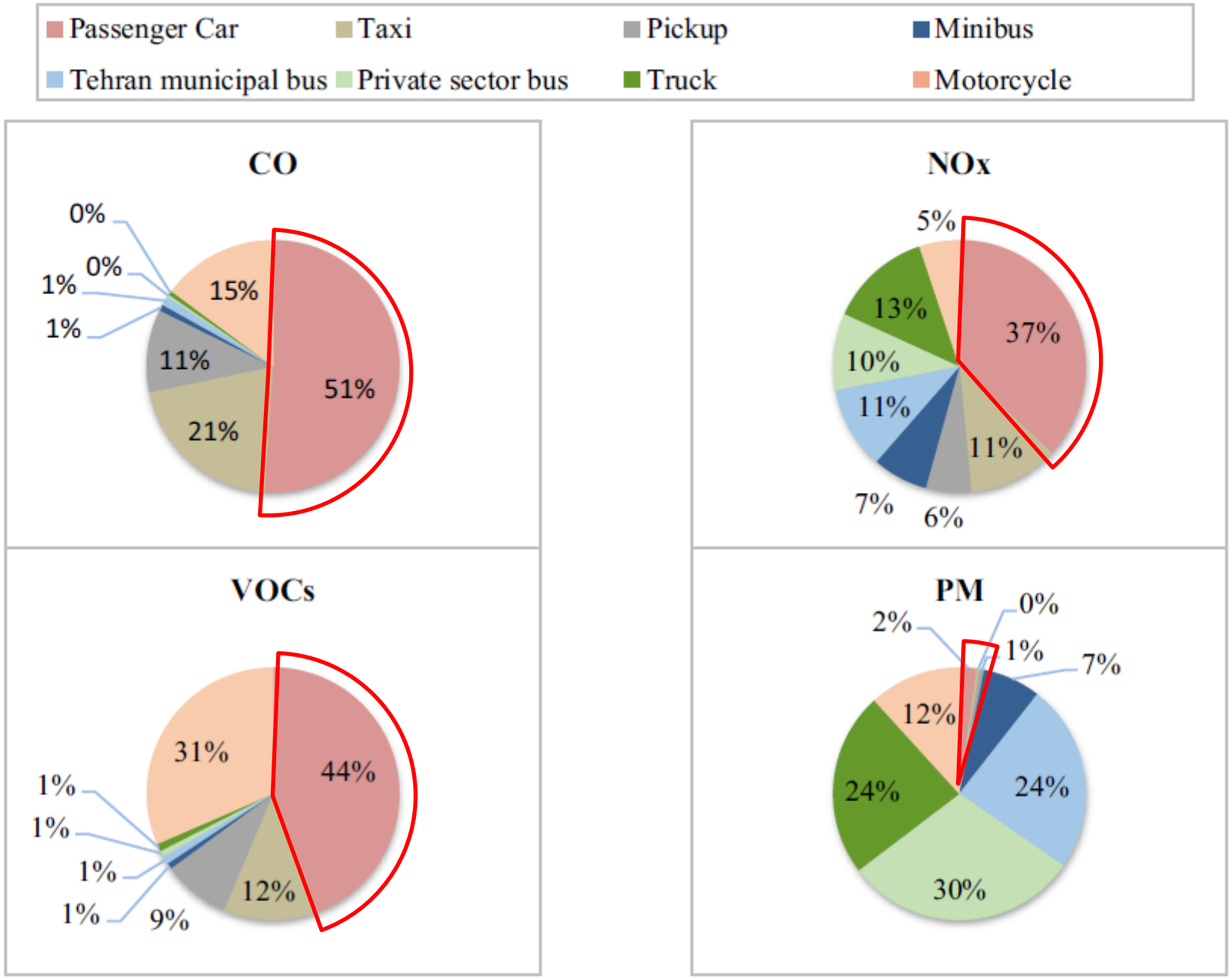
Emiss. Control Sci. Technol. (2016) 2:44–56

Divisions between various fleets among mobile sources



Emiss. Control Sci. Technol. (2016) 2:44–56

Gasoline and CNG vehicles



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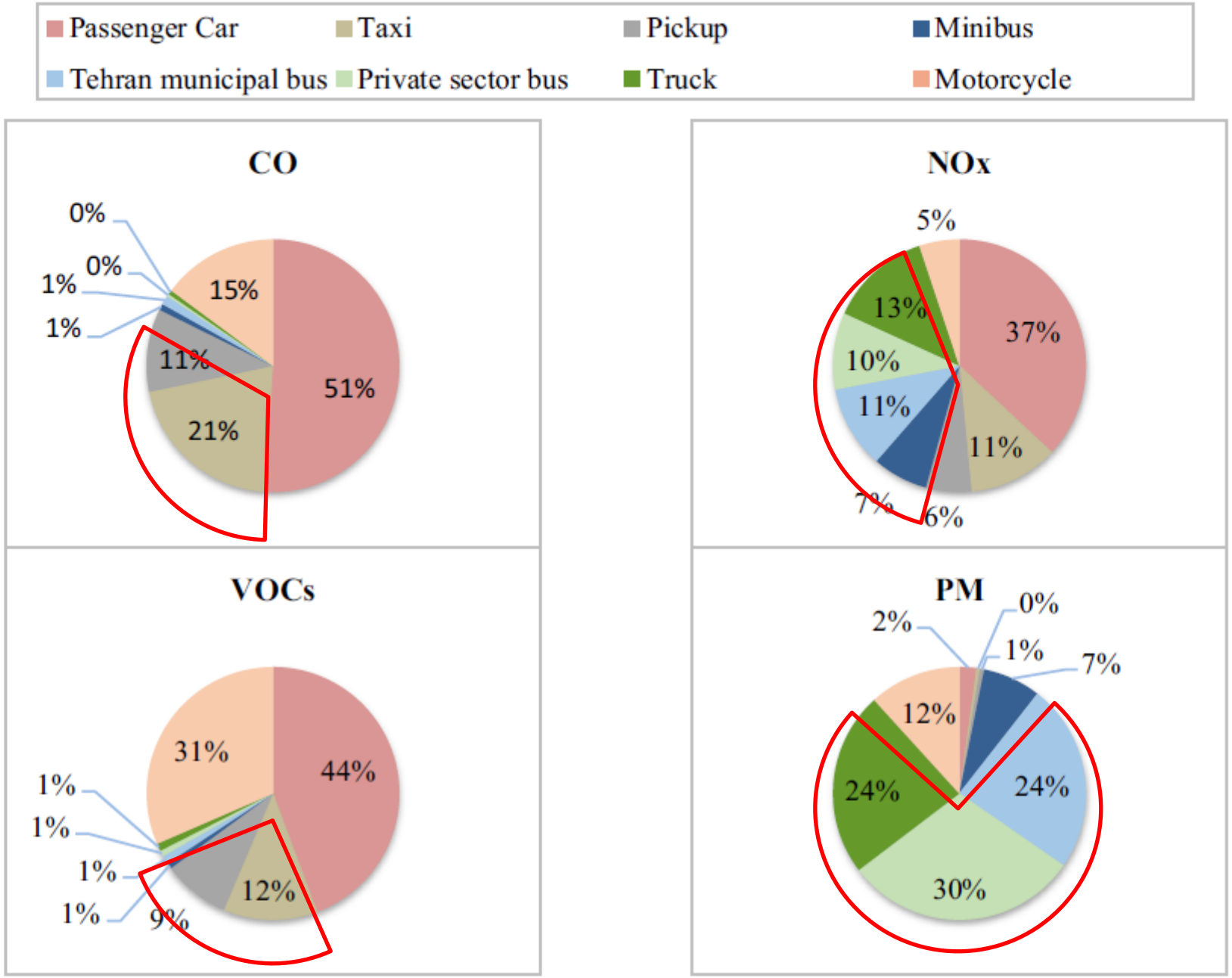
Diesel vehicles



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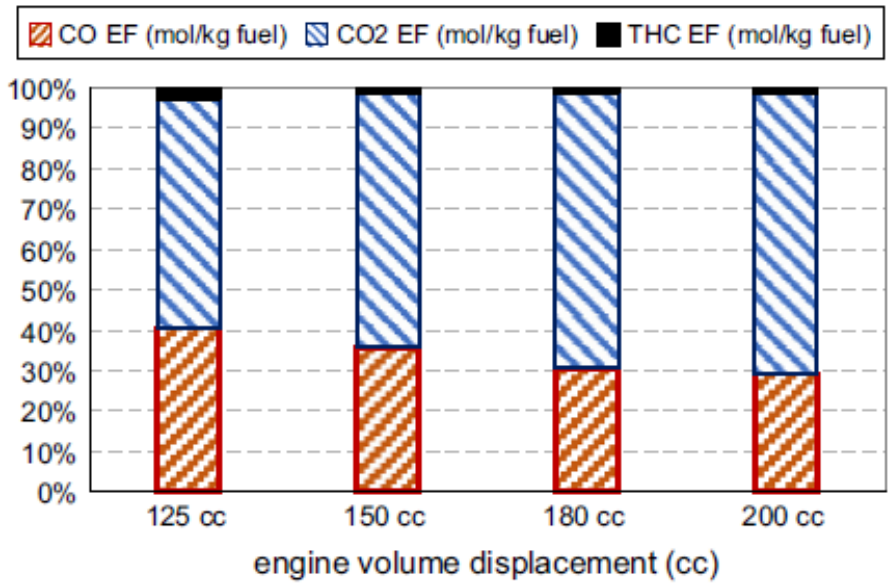
The issue of motorcycles



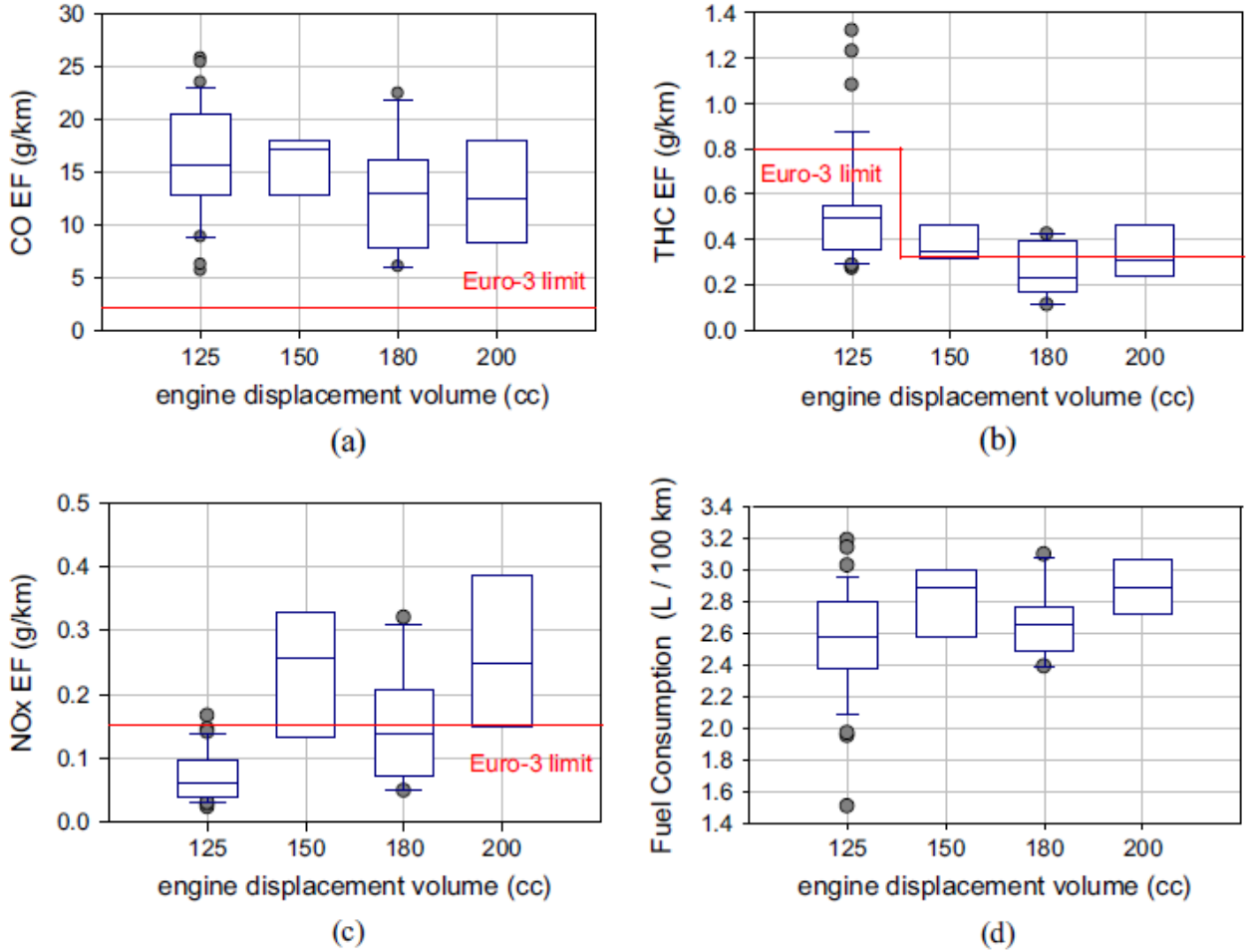
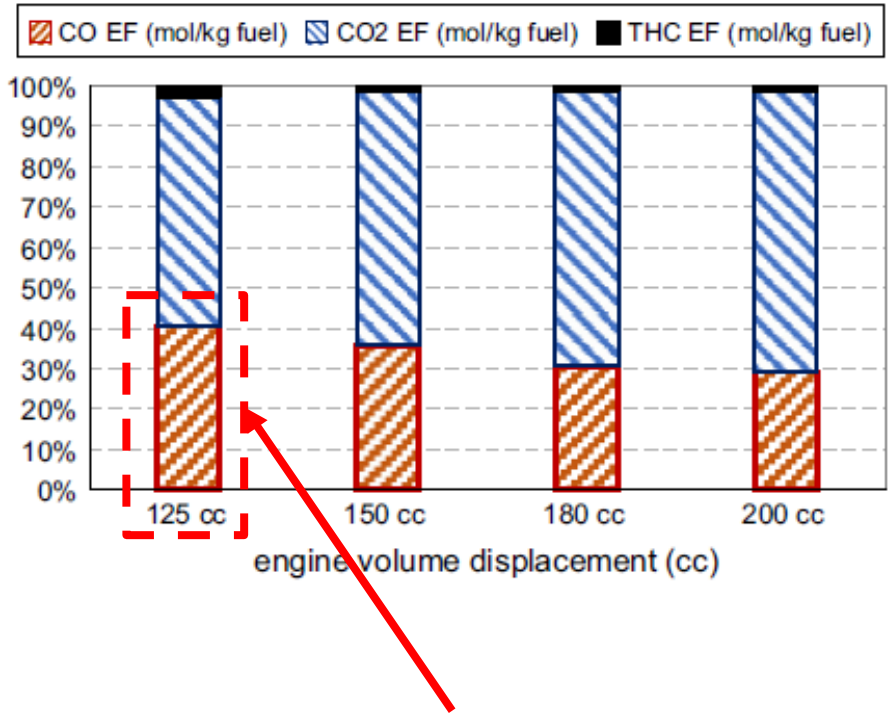
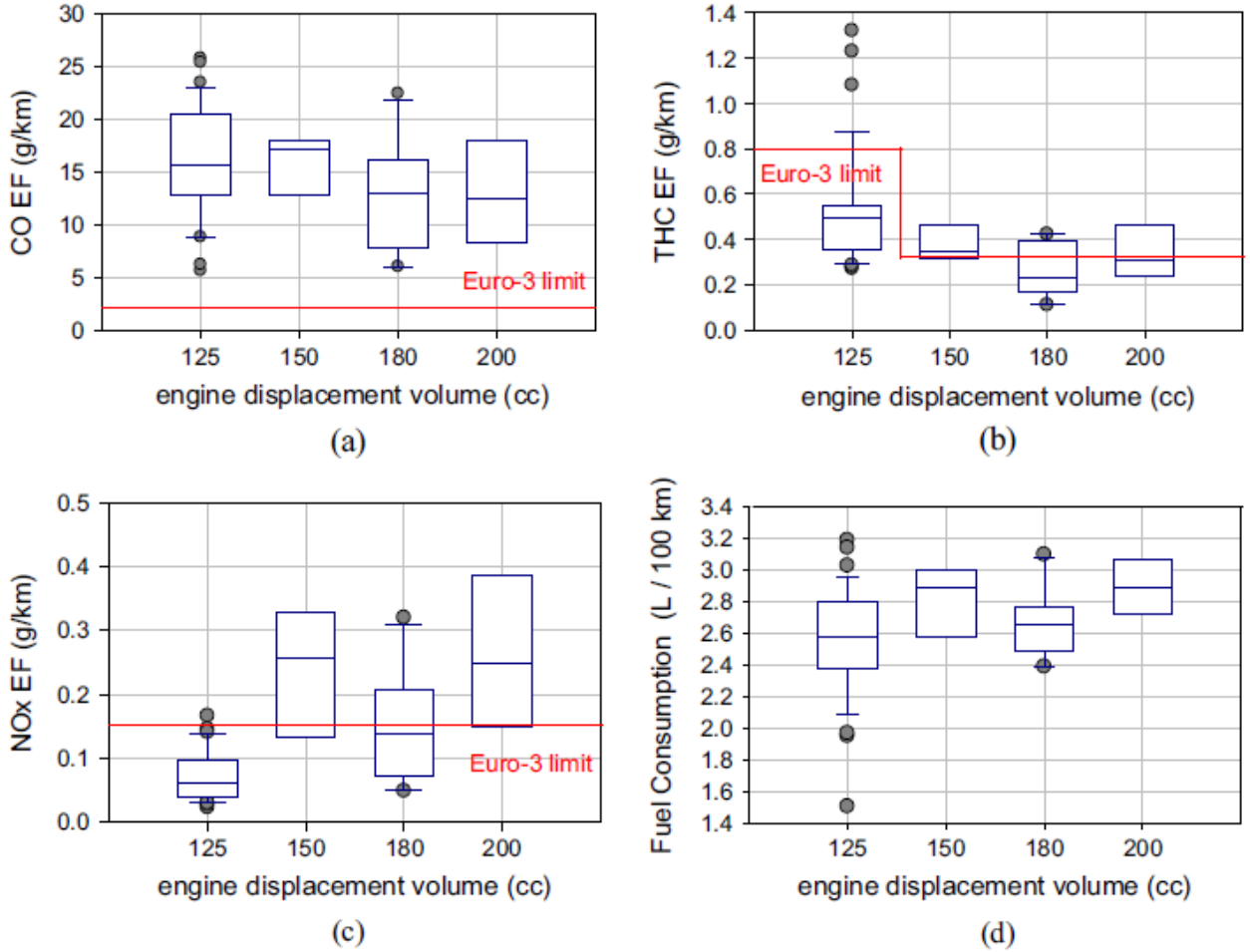


Fig. 4. (a) CO, (b) THC, (c) NOx, and (d) fuel consumption emission factors for selected Tehrani motorcycles. Results procured from cold start Euro 3 chassis dynamometer tests, along with Euro 3 emission limits.

The issue of motorcycles



Close to half of the fuel is not completely burned
→ lots of CO, BC, and UFPs



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Source apportionment for PM2.5

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PM2.5 source apportionment study

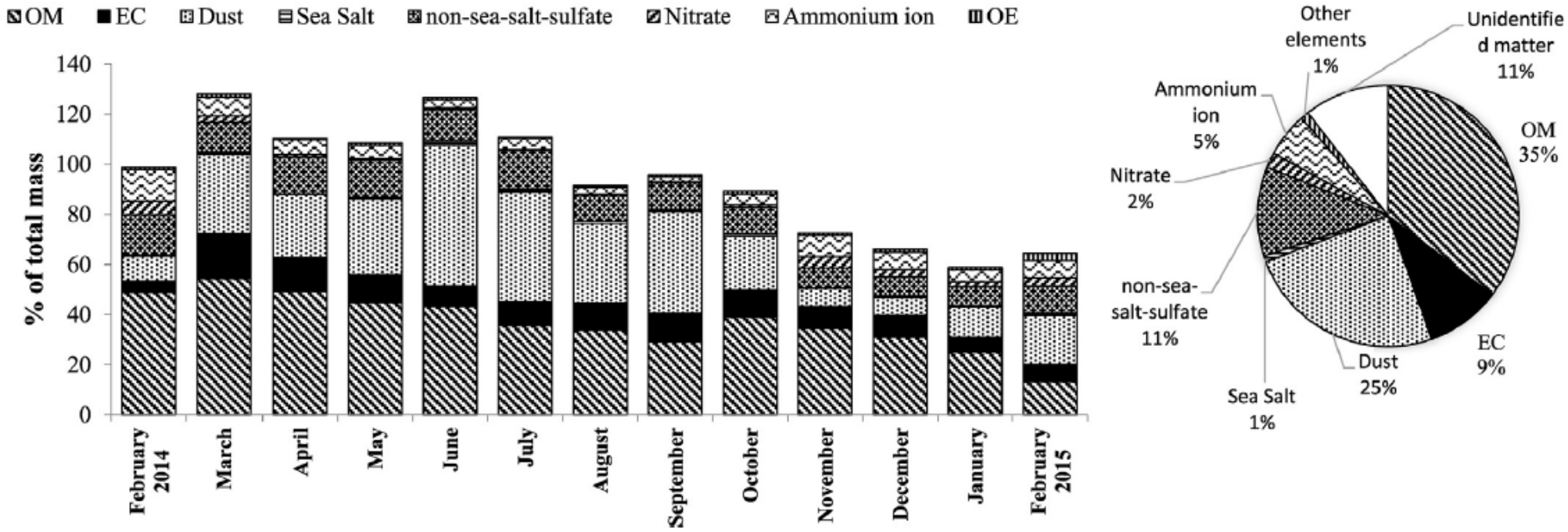
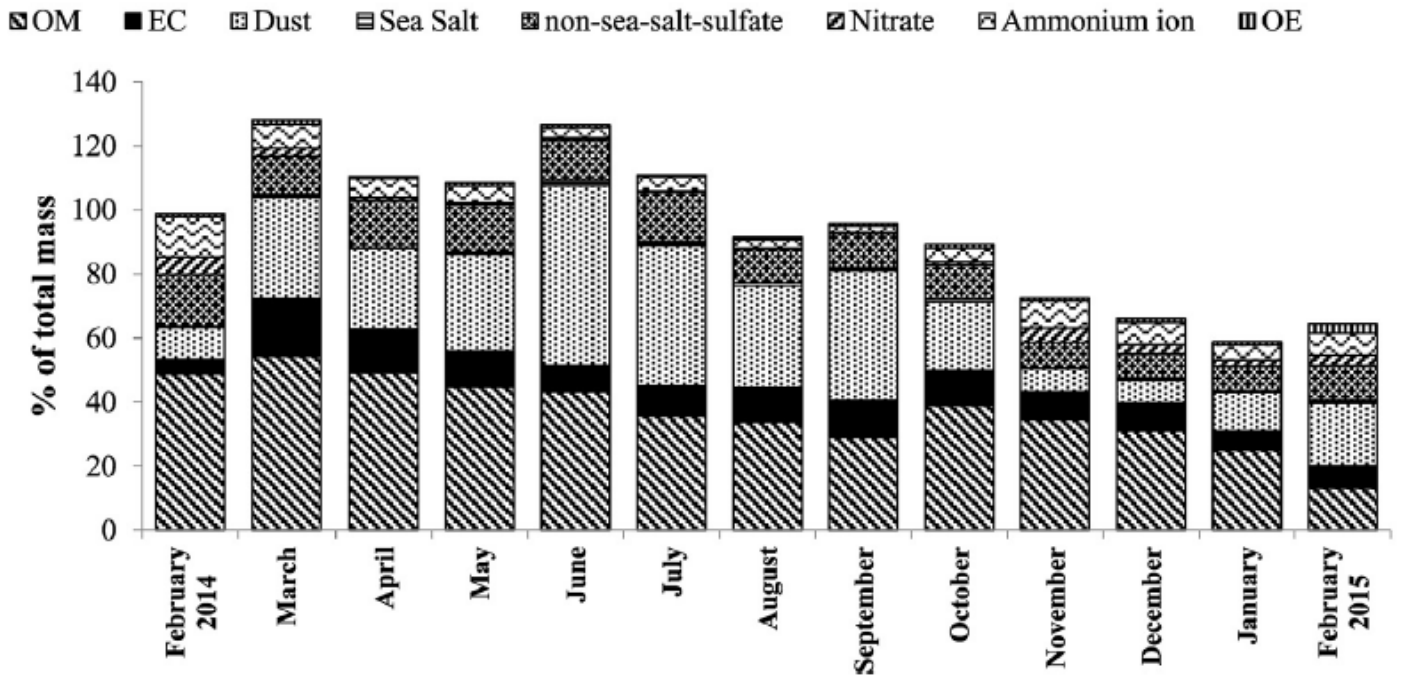


Fig. 2. The contribution of major mass constituents to $PM_{2.5}$ in Central Tehran.

M. Arhami et al. / Atmospheric Environment 153 (2017) 70–82

PM2.5 source apportionment study



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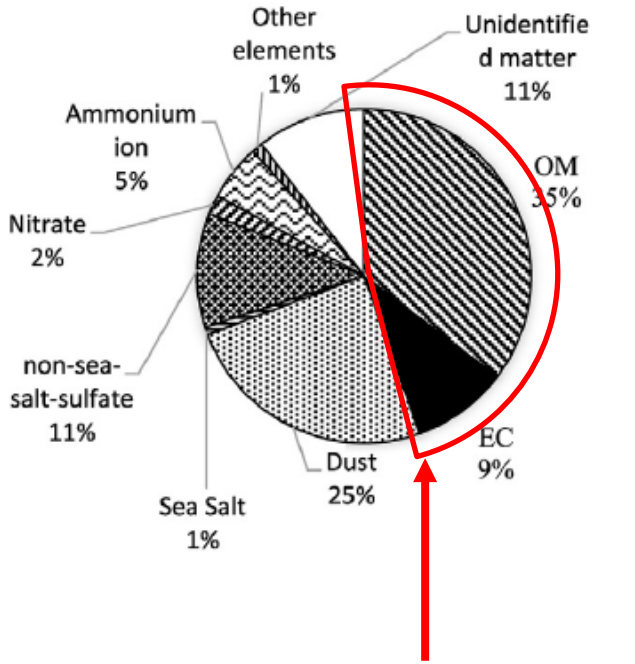
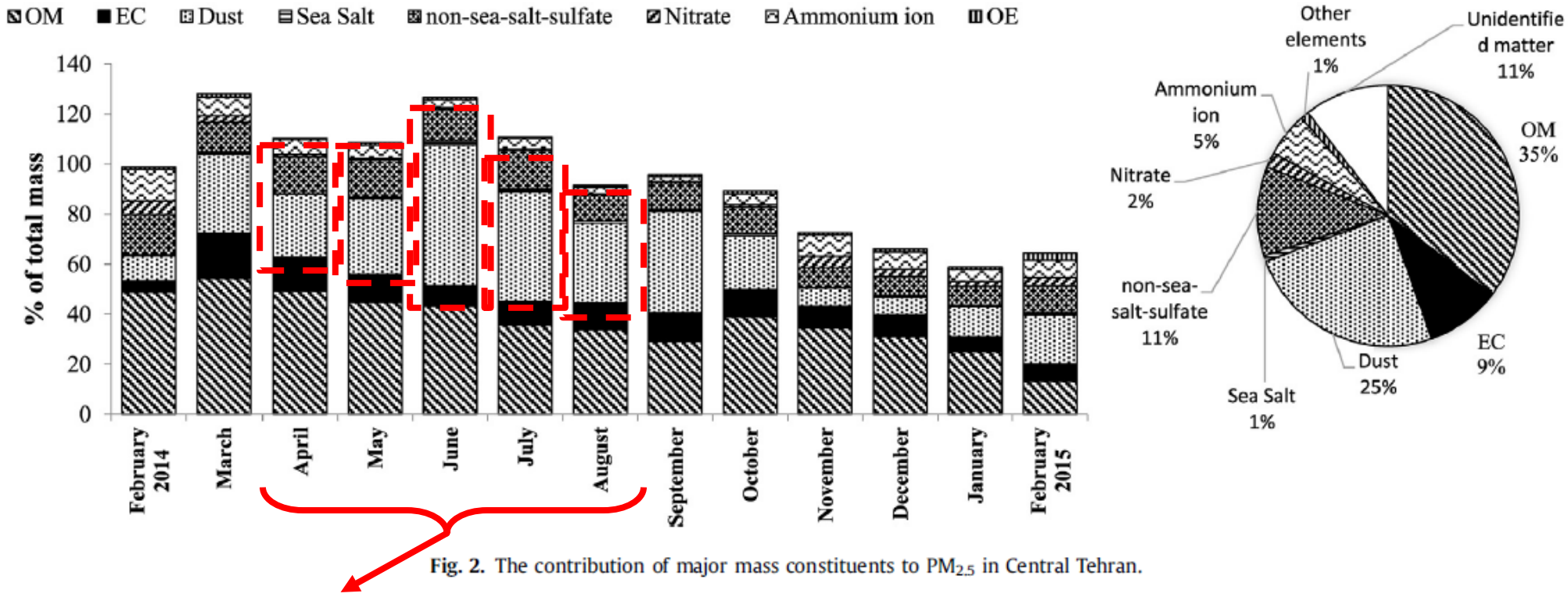


Combustion sources contribution

PM2.5 source apportionment study



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Spring and summer dust

M. Arhami et al. / Atmospheric Environment 153 (2017) 70–82

PM2.5 source apportionment study

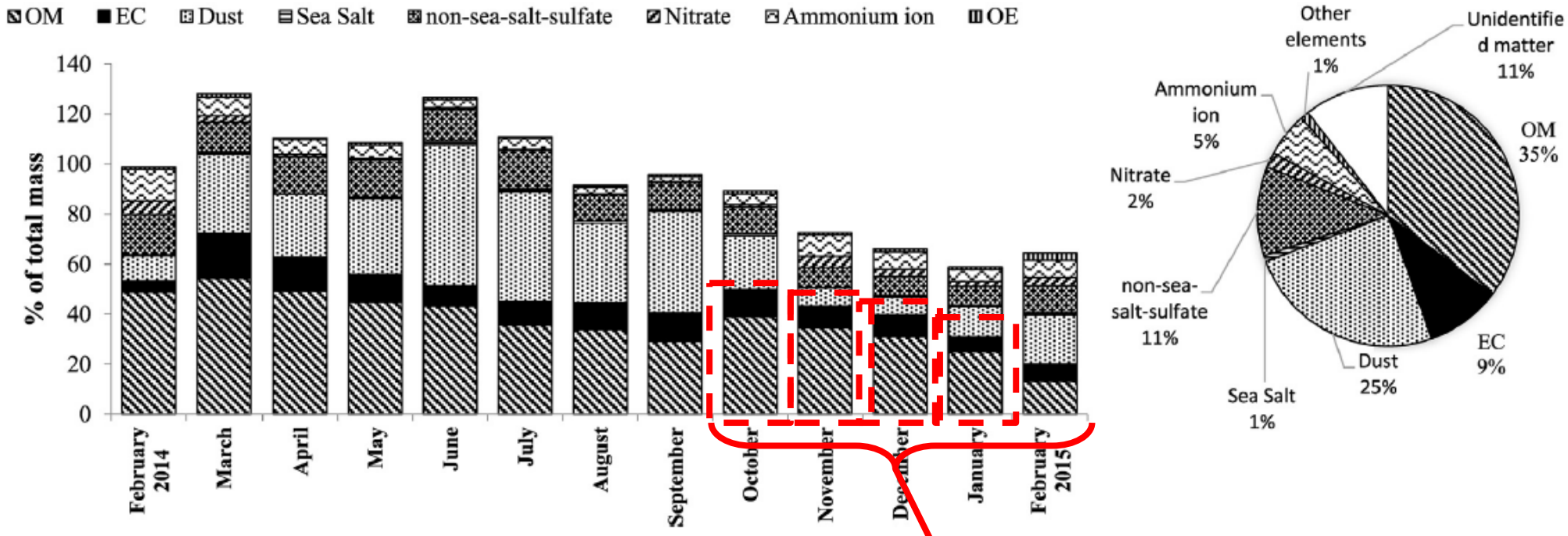

Fig. 2. The contribution of major mass constituents to $PM_{2.5}$ in Central Tehran.

Fall and winter OM coming from combustion and intensified by inversion periods

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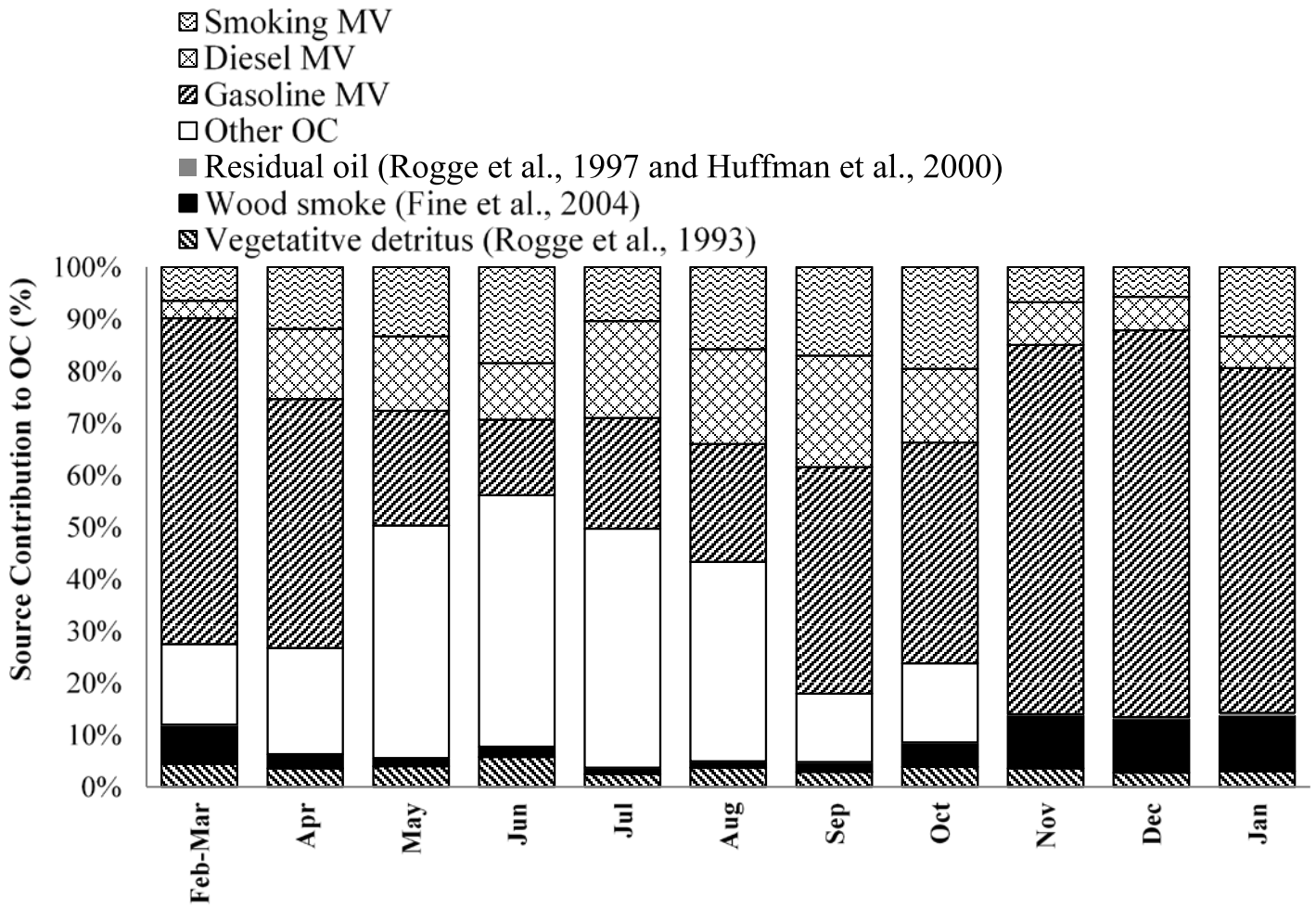
Results of CMB receptor modeling based on PM2.5 chemical analyses, OC apportionment

(Accepted for publication, 2018)



Organic carbon (OC) contribution by various sources, importance of the role of secondary organic aerosols (SOA)

Results of CMB receptor modeling based on PM2.5 chemical analyses, OC apportionment

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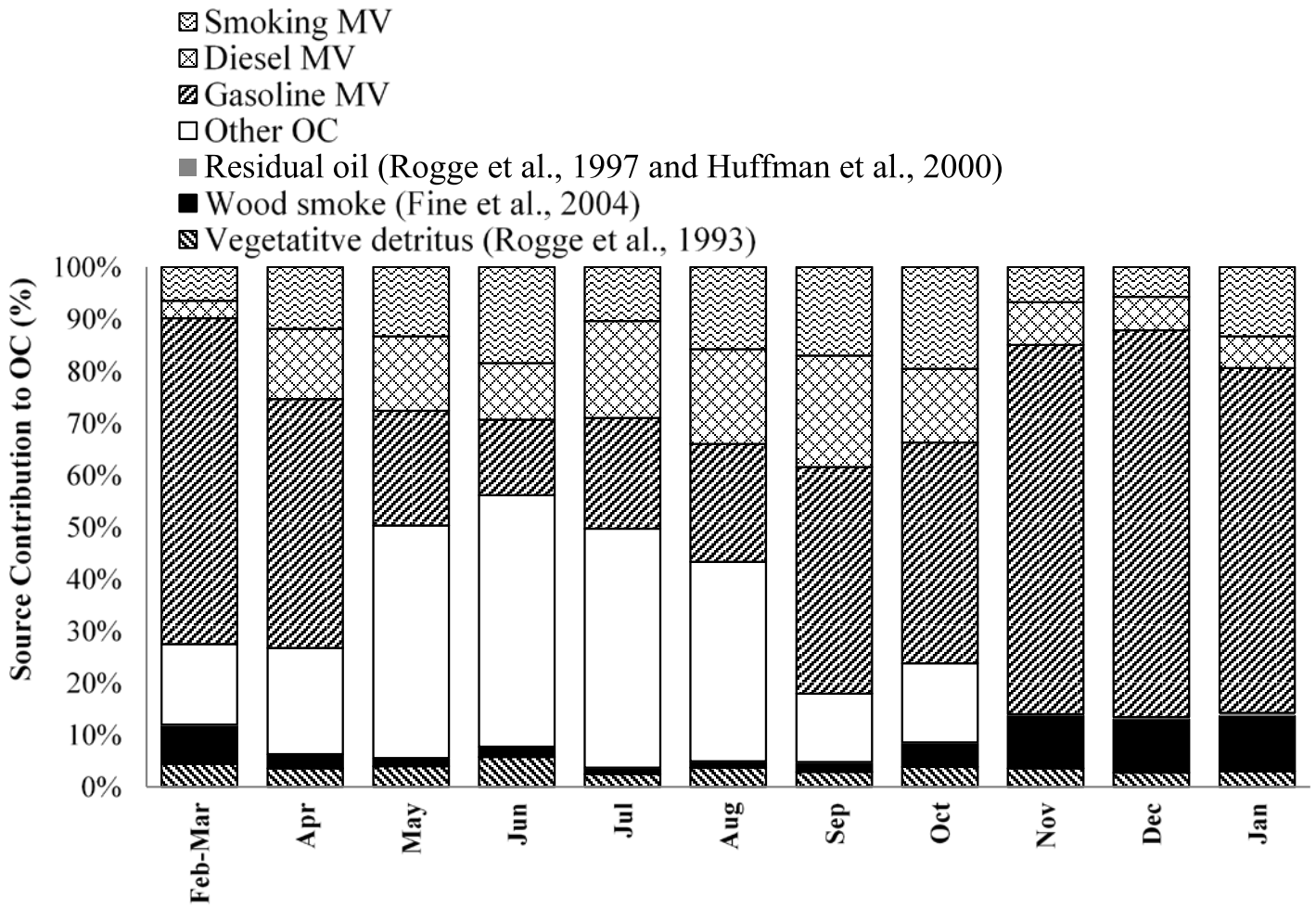

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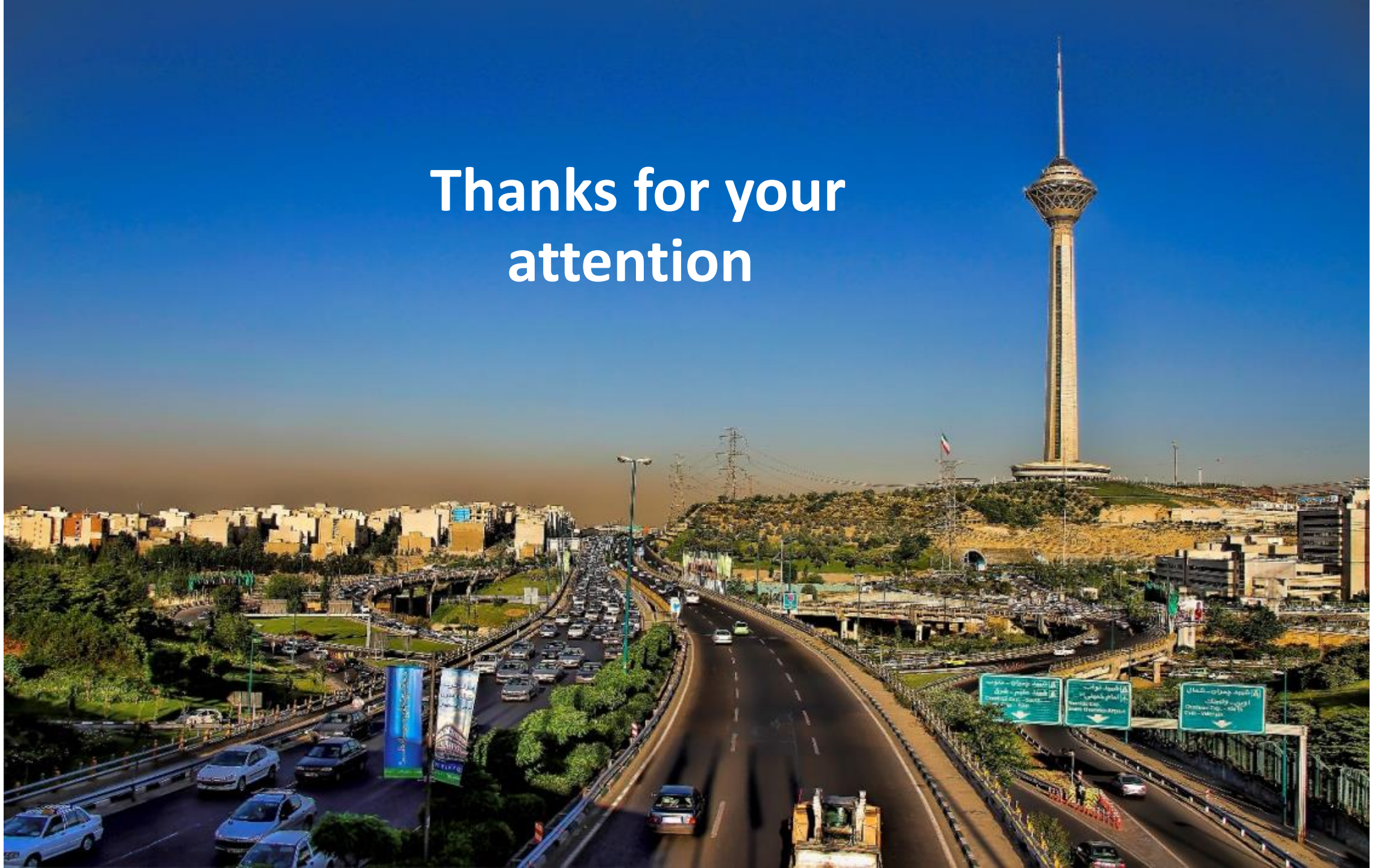
Thanks for your attention